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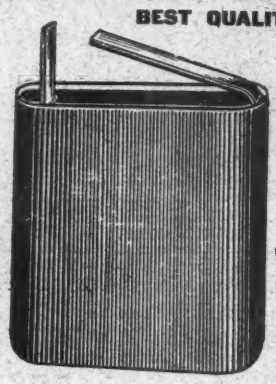

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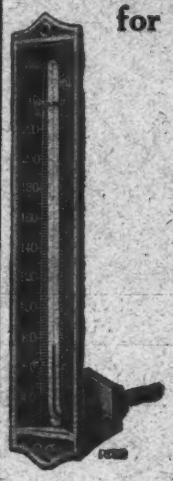

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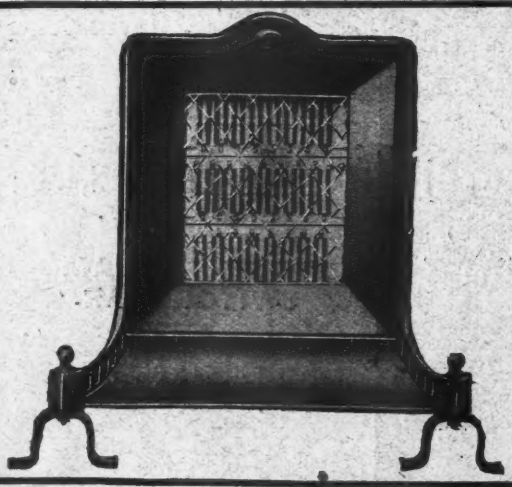

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THE
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ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: March 30, 1917. [No. 2,053.

	Page
Coal Winding Problems	337
Women in the Engineering Industries	338
Some Notes on the Electrical Driving of Workshops and Factories, by A. T. Bullen	339
Equipment of King George Dock, Hull (*illus.*)	341
The Voltage Regulation of Rotary Converters	343
Correspondence—	
Electricity Supply Rates and Government Contracts	344
The Controller Drum	344
Oil-Immersed Circuit Breakers for use on Continuous Current Supplies	345
Linking-up with Waste Heat Stations	345
Women and "Shorts"	345
Fault Localisation	345
War Items	345
Legal	347
Notes from Canada	347
Trade Statistics of Canada	348
Business Notes	349
Notes	352
City Notes	355
Stocks and Shares	357
Market Quotations	358
Exports and Imports of Electrical Goods during February, 1917	359
The International Aluminium Industry	360
The Faraday Society	360
Frequency Changers (*illus.*)	361
Diesel Engine Users' Association	363
Foreign and Colonial Tariffs on Electrical Goods	363
New Patents Applied for, 1917	364
Abstracts of Published Specifications	364
Contractors' Column	Advertisement page xx

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COAL WINDING PROBLEMS.

IN his presidential address to the South Wales Institute of Engineers, Mr. Hugh Bramwell took as his subject "The Raising of Coal from Vertical Shafts," tracing the various historical phases of the subject from as far back as 1750-65, when the hand-winch gave way to the horse-gin, and hourly outputs of 10 to 20 tons of coal were raised, up to the present time, when the electrical winder is rapidly establishing itself in favour. With the introduction of steam winding, speeds and outputs greatly increased, and in 1894 four and six-ton loads were lifted at average speeds of 35 ft. per second, giving outputs of 350 tons an hour; at the present time, however, a reversion has taken place in South Wales to slow-speed winding with a materially heavier load than has hitherto been adopted.

Up to 1870 the ropes were usually balanced in deep mines by means of balance-chains working on the drum-shaft and dropping into shallow staple pits. About 1874 the balance-chain method gave place to tail-rope balancing or to the conical drum. About 1905 the cylindro-conical drum was introduced, in which the acceleration of the masses is supposed to be completed and full speed attained with the two ropes on the maximum and minimum diameters respectively.

In 1914 the author introduced the subject of recoiling the rope on itself in layers, to the Institute, this being a means of keeping the diameter and width of drum within practical limits, where considerable rope-carrying capacity is required. The author gives an appendix containing a comparison between five more or less representative types of winding plants, which disclose the struggle between load and speed.

The Wearmouth "B" Pit engine of 1868 represented a reversion to slow speed with a heavier load (max. and av. speeds, 20 and 18 ft. per sec.; coal weight, 8,960 lb.); the Silkstone No. 2 (1872), Hickleton (1894), and Penrhiwceiber (1906) show that the load is maintained, but speed increased (the three examples give max. and av. speeds of 45 and 36, 50 and 36½, 59 and 38½ ft. per sec. respectively, with coal loads of 8,960, 9,856, and 10,080 lb. respectively). These are followed by the Cwm (Llantwit Fardre) electrical winder of 1914, again showing a reversion to slow speed and heavy load; in this case the max. and av. speeds are 28 and 21 ft. per sec., and the coal load is 26,880 lb. The Penrhiwceiber and Cwm winders each have a capacity of 360 tons per hour in full work.

The author says "the inference is that speed is controlled by wear and tear of the plant and, pos-

sibly, by safety; whilst the load is chiefly controlled by the improvements in rope construction. Incidentally, it may also be noted that with slow speed, cages may properly be very much lighter than with high speed, and therefore the proportion of effective load (coal) is materially improved. In this connection, it may also be pointed out that the life of a rope is related chiefly to the number of winds it makes, and, provided it is of reasonably adequate strength as compared with the load, its life is not so much influenced by the total weight raised; doubling the load halves the number of winds, and this, with reduced speed, must largely favour rope conditions."

The author concludes that a heavy load pays better than high speed, provided this is not attained at the cost of an unreasonably heavy initial outfit, and gives his opinion that for depths of 3,000 ft., which are being approached in practice, development may properly tend towards an equipment on the lines of a hotel or warehouse lift. The present single rope to each cage which both suspends and actuates the load may be replaced by a suspending rope common to both cages, and working over a pulley on the headgear, with subsidiary operating ropes to each cage from the winding drum. The former rope would thus suspend the load, and would be relieved of all acceleration and retardation strains. The actuating ropes, on the other hand, would be relieved of the suspended weights, and their work would consist of accelerating and retarding the masses only.

An arrangement of this kind would reduce rope sizes and weight of winding equipment, and render stage winding still less necessary. The Koepe system, employing a single frictional winding pulley, is somewhat similar, but the author's proposal differs in the separation of the suspending and actuating ropes; the Koepe arrangement has not been adopted to any extent here, its drawback being that there is no spare rope available for cutting and recapping —the cap end of the rope being the part where trouble is expected—and the author hints that his proposed arrangement shares this disability. Apparently the life of a winding rope averages about $3\frac{1}{2}$ years, and recapping is necessary at intervals of not more than six months, to comply with Government regulations.

Mr. Bramwell's address contains matters of considerable interest to electrical men, first because his proposal would mean a radical departure from the strongly entrenched practice of the past, which has proved such an obstacle to the introduction of electrical winding, and, secondly, because it directly favours the adoption of the latter method. Obviously, the separation of the static and acceleration loads would, as the author states, lead to a reduction in weight of winding equipment, and, other things being equal, a reduction in winding speed also favours the same result, and this, in view of the heavier pit-head structure which would no doubt be called for with heavier loads, points strongly towards the adoption of the pit-head position for the winding or hoisting gear as the correct one. Electrically-operated winding gear, or that portion of it required for operating the winding drum or pulley, as the case may be, is eminently suited to such a position, whereas steam winding gear must of necessity occupy valuable space and buildings on the ground. Several well-known Continental electrical winding installations utilise the top of the pit head structure, generally, we believe, with the Koepe winding pulley, but in one instance with winding drums; in any case, with Mr. Bramwell's proposed arrangement, it would appear that the weight of winding equipment as a factor in the constructional arrangement would be so far reduced as to make the pit-head position, with electrical winding gear, a proposition worthy of close consideration.

The disadvantages incidental to the question of recapping should not be taken too seriously; there are possible ways and means of taking up the stretch in a rope and providing a sufficient margin for recapping—not, of course, without introducing some departure from simplicity. The simplest arrangement of all would appear to be an endless rope, passing through the cages, if that were feasible, with a guide pulley, adjustable for slack rope in a sump at the pit bottom; the cages could then be clamped to the ropes, and their position adjusted at intervals to distribute the wear evenly over the ropes. As an alternative, the excess rope due to stretching, or that required for recapping, might be stored on a small drum at the top of the cage, which would provide the necessary adjustment in length. We feel assured that the problem will provide no insuperable difficulty to the mining engineer—in any case, such difficulty will be trivial compared with those over which the electrical engineer has triumphed in bringing the electrical winder to its present position as a practical machine.

Women in the Engineering Industries.

The Ministry of Munitions (Labour Supply Department) is holding an exhibition this week at the Royal Colonial Institute, in Northumberland Avenue, W.C., which has doubtless been visited by many gentlemen responsible for the employment of labour in engineering industry. Those who have not had an opportunity of attending in response to specially issued invitations, since the opening of the Exhibition by Mr. F. Kellaway, M.P., on Monday afternoon last, would do well to make a point of doing so before the closing hour to-morrow (Saturday) afternoon, for the photographs and materials brought together form a unique, instructive, and most timely collection, demonstrating the thousand and one various types of work upon which women are being employed in engineering and other industries on munitions of war. The manner in which women have come to the assistance of the Empire in taking the places of men of fighting age and fitness, and in facilitating the most necessary work of dilution, must fill us all with admiration, but it is of the greatest possible importance that the movement, with its magnificent record, should not stop where it is. There is need for the employment of female labour to be carried much farther than it has yet gone, for the number of fighting men must be increased continuously until the enemy has been utterly defeated, yet the output of munitions for their use must be maintained at all costs. Of course, it is no new thing for women to be engaged in lamp-making, armature winding, accessories manufacture, and so on, but at this exhibition there is brought together a collection of articles of many other kinds upon which they have brought their now proved adaptability and deft fingers to bear. Sparking plug parts, complete magnetos, lamp-holders, armature parts, lighting switchboards for mechanical transport work and scientific instruments, are among the purely electrical examples upon which women have worked either at drilling or milling, winding, engraving, assembling, and so forth. But

the collection of photographs carries us into classes of labour where before the war female labour, if not unknown in this country, was almost a curiosity. They depict women engaged in a host of operations involved in general engineering, shipbuilding, and marine engineering, tool-room and precision work, small arms work, the manufacture of parts of internal-combustion engines; they show them engaged on wiring and rolling mills, operating all kinds of lathes and similar machinery, building small commutators, operating presses for armature work assembling ironclad switchgear, erecting switchboards, driving 40-ton cranes, in charge of motors on industrial installations, driving electric trucks, electrically welding electric contact mines, operating a 500-KW. switchboard, and attending a 300-KW. direct-coupled engine set and a 1,000-H.P. steam engine. These are a few of the pictures now on exhibition; our reference is not by any means exhaustive, but we think it may be taken as indicating the very wide field of service in which female labour, after suitable training, has proved to be not only applicable, but very successful. The progress which these examples and photographs represent has been remarkable considering all the prejudices which have naturally been encountered by those who have striven to bring about, if not a revolution in industrial life, a remarkable extension of the use of a class of labour which was not rightly valued, probably because there was not the same need, in normal times. Prejudices from Labour; prejudices from Employers and their management and staff; prejudices from women themselves; all called for tact, enthusiasm, and determination if this, the only means of enabling us to carry the war through to an unquestioned victory, was to be availed of. Of course, those prejudices have not yet been entirely removed from any of the three classes, although they are disappearing more and more as our leaders, political, labour, industrial, and social make absolutely definite the necessities of the situation and the inevitability of women taking a new place in the world until the present emergency has passed right away. Fear and suspicion on the part of male workers as to the position of certain classes of trades after the war, consequent upon the change, still lurk beneath an apparently calm surface; unwillingness and want of conviction as to the suitability of women for certain classes of work still mark the attitude of some employers; and many women continue to show a predilection for classes of service which normal times have proved to be their natural avocations. But we are governed today by the dictates of absolute necessity, and for the time being all will do well to pack up their prejudices, as the soldiers do their troubles, and find a way for doing their bit to further, in the interests of the great cause of Civilisation, the employment of women in the engineering factories of the United Kingdom. If the call of the War Office is for men of fighting age and fitness, that of the Ministry of Munitions is for women, more women, and still more women for our factories in order that those fighting men may do their part with a minimum loss of life, and by hastening the end save millions of treasure also. Our after-the-war problems may seem to be increased with each successive step forward in disorganisation, but who can show suitable alternatives to present methods? Further, may it not well happen that instead of being detrimental to the national industrial situation that follows the war, the availability of a vastly larger volume of skilled and semi-skilled female labour will be an asset of immense value when we resume the manufacturing operations of pre-war times on what we hope will be an exceptional scale, calling for the co-operation of all the demobilised fighting men, and all the new industrial women, in the building up of greater industries than have ever been ours in the past?

SOME NOTES ON THE ELECTRICAL DRIVING OF WORKSHOPS AND FACTORIES.

By A. T. BULLEN.

Electricity as a source of power is now well known in most of the larger factories in this country, and, generally speaking, the operatives in those factories have every reason to be satisfied with it. A man brought up in the traditions of steam or gas power is not always willing to change over to electricity; but having put it to the test, and overcome his natural mistrust of a new thing, he will usually speak highly of the steadiness, constant speed, and reliability of the new driving power, and, more than that, he would not revert to the older forms even if he had the opportunity.

In the larger factories, the owners, too, have every reason to be satisfied, for on account of the large quantities of electricity consumed, they are usually able to arrange terms which make it not only a reliable, but a very economical form of power.

In the smaller factories and workshops, however, we do not always find the same satisfactory conditions, and the price per unit will not work out to anything like the economical figure reached in the case of the larger factory.

There may be two reasons for this; the first due to the method of payment, and the second the result of the method of installation.

If the supply is charged for on the flat-rate principle we usually find a considerable rebate allowed on very large consumptions. If, on the other hand, the charge is based on the maximum demand the large factory scores again by reason of its diversity factor. A small workshop of about half-a-dozen machines will often get them all on together, which will make the demand high compared with the number of units consumed, whereas in a factory with, say, 100 machines it is probable that not more than 80 will represent the maximum load, so that the relative number of high-priced units is less, which means a corresponding drop in the average price per unit for the whole consumption.

But the number of consumers dissatisfied on account of the prices charged is few compared with the number whose dissatisfaction is proved to be due to errors of installation and power wasted in driving shafting and the like.

In a large factory electric driving would rarely be installed except as advised by some prominent and capable engineer. This authority would prepare a plan of the shop, and would arrange the whole thing on economical and efficient lines, whereas, in the case of a small workshop, an expert authority would rarely be consulted, the work, more often than not, being entrusted to inexperienced local contractors who have been used to wiring anything up to 20 points for lighting, but, beyond occasionally cleaning a motor or fixing new brushes, have had little to do with them or their uses. The result is inefficiency and expense.

Here is a case in point. It is a small printing works boasting, in all, 17 machines. The majority of these machines are small, the largest of them taking less than 1 H.P. to drive it. The average load, measured by the electrical input into the motors, of which there are two, is 10·7 H.P. (independent of the motor losses), and of this quantity only 3·7 H.P. is useful work, the remaining 7 H.P. being absorbed in driving the shafting.

Either or both motors may be used, but, whichever method is chosen, the whole of the shafting is running continuously, and 5·2 units per hour are registered on the meter. When both motors are used, the first one drives seven machines, and, in addition to its main shaft, requires two countershafts. The second motor uses six countershafts in addition to its main shaft to drive the remaining 10 machines.

Can it be wondered at, that the proprietor of this establishment is not satisfied with the cost of his electric power? Yet he will not seek expert advice in order to improve the conditions, and so he rubs along, grumbling all the while, but paying all the same.

The case of this printer is by no means an isolated one, and few realise the enormous amount wasted in the trans-

mission of power by mechanical methods—such as shafting, belts, or ropes. When installing electrical driving many simply replace their steam or gas engine by a large motor, still retaining all the power-wasting belts and shafting. This is obviously wrong, and the power is likely to cost as much, or more, than previously. The correct method is to subdivide the works as much as possible into sections (it is rarely possible or advisable to fix a separate motor on each machine, although this is the theoretical limit), and to provide a separate motor for each batch of machines. This will save much countershafting, and will, moreover, allow of certain machines being used without the necessity of running the whole of the shafting.

Where a considerable amount of shafting is really necessary, care should be taken to reduce the friction to a minimum. For this reason, ball bearings should invariably be used. Their first cost is comparatively high, but that this expense will soon be repaid by the saving effected on the electricity consumed is clearly shown by the following figures:—

A certain consumer had a motor driving two machines, and he wished to add a third; but as he was not sure if the motor would take the extra load, he wrote to the Corporation for advice. A test was made, when it was discovered that his shafting, which was 20 ft. long, supported by three bearings, took 2 KW. to drive it. He was advised to substitute ball bearings, which he did, at a cost of about £10. A second test was then made, and it was found that his shafting losses had been reduced to ½ KW. His running hours were about 30 per week, so that, in the first instance, 3,120 units per year were consumed in driving the shafting, which at 1d. per unit cost £13. Now these losses have been reduced to ½ KW. the cost per annum is £3 5s., so that in one year a clear saving of £9 15s. has been effected, which is practically the first cost of the ball bearings.

As much power as is lost in friction in the shafting is often lost in the belting used. A man who substitutes a motor running at 1,500 R.P.M. for a gas or steam engine running at about 200 R.P.M. will frequently use the same heavy belt to save the cost of a new one. This is a great mistake, for at the higher speed a much lighter belt will suffice, and its cost will soon be saved in electric power.

As an example of power lost in a rope drive, the following would be hard to beat. In the engineer's office of one of our municipal generating stations, in a district where pottery is among the staple industries, there hangs a photograph of a 1-H.P. motor. This photograph is a source of just pride, and the engineer is ever ready to tell the story of its distinction.

The machinery in the pottery where this motor is now installed was originally steam-driven, but it was one day decided to consider electric driving, whereupon the electrical engineer was approached, and asked to give advice on the subject. Having examined the machines to be driven, he decided that a 2-H.P. motor would provide ample power, and was subsequently asked to install it. This he did, only to find that it would not move under load. A 5-H.P. motor was substituted, but was little better; even a 7½-H.P. gave results far from satisfactory, and eventually a 12-H.P. motor was installed. The engineer, however, was not satisfied; he considered his reputation at stake when it was found necessary to install 12 H.P. to do work which, he said, could be done with 2 H.P. He knew there was a great loss and wastage of power somewhere, and asked to be given a free hand, in order to reduce this loss. This he succeeded in doing, and to-day the whole of that machinery is driven by this 1-H.P. motor.

The steam engine was reckoned as 6 H.P., and the driving of the various shafting and machines had been carried out by means of a very long rope, which ran practically all round the pottery. It is probable that only about 10 per cent. of the power used was usefully employed, the rest being absorbed in the absurd rope drive.

Much of the loss and wastage of electric power indicated above, arises out of the short-sighted policy of many factory owners and their contractors, and it is particularly to contractors that these words are addressed.

In a very large number of cases, the change to electric driving is a gradual process. Comparatively few will suddenly change their whole factory to electric driving, since few are ready to be guided by the experience of others. It sometimes happens, however, that perhaps the insurance company have condemned a boiler, when the complete conversion usually takes place. More frequently, though, it is decided to install, say, a 5-H.P. motor, so that a personal trial and investigation can be made. In such a case, this motor will probably drive an individual machine, when all the advantages of electric driving will be derived. Extensions will follow, and it is then that the contractor must be very careful, for he will not be able to give an individual drive to each machine, and unless he adopts practical measures to keep down the driving losses, the final results will be much less satisfactory than those given by the trial motor.

If he is wise, the contractor uses whatever influence he has, professional or personal, to persuade the proprietor to convert the whole factory at once. It is a good plan to keep in close touch with other power users in the district, who are usually willing to allow new electrical clients to inspect their workshops and arrangements; but if, after such inspections, the doubting one still desires to make a personal trial, then the certainty of future extensions, and the absolute necessity of allowing liberally for them, should be impressed on him. It will cost more in the first place, but it will mean a considerable saving later.

Before installing any one motor, a complete plan of the works, embracing all the possibilities of electric driving, should be made, and a central position chosen from which the supply of power will radiate. Here install a substantial distribution board with plenty of room for new circuits, and then run some heavy leads to the supply service. When the extension comes along, you are ready for it, and instead of having to run all round the shop to the point of supply, you simply run a pair of leads from the specially situated distribution board to wherever they are wanted. The scheme never becomes patched, and the hopeless tangle of wires we so often see round the meter and cut-outs, is avoided.

Further, the foundation is laid for the individual driving of the various sections of the works, which is so essential if the final results are to be up to the standard fixed by the original trial motor. There is no risk of changing over to one large motor and then finding that the power wasted in the shafting and belting brings the cost up to, and perhaps even more than, that of the older method of driving.

A word now as to the wiring. Do not spoil an otherwise good job by cheap, and therefore poor, wiring. If the price is not reasonable, it is better for neither the factory owner nor the wiring contractor to accept the work. Good work can always demand a fair price, and those who undertake cheap work, immediately brand themselves as second-rate contractors.

Electric motors, as a rule, require but little attention, and for this reason they very often get none whatever until something goes wrong; but although many motors have been known to work for 10, or even 15, years without attention, it is advisable to examine them occasionally.

It is a good practice to put in circuit an ammeter, which will give an excellent indication of the load or the condition of the motor and equipment. The mechanic or electrician responsible for the motor gets to know about how many amperes should be registered, and if he finds the current going up he knows that something needs attention, and thus faults are checked and quickly rectified.

Consumers will find the officials of the supply authorities always willing, out of their varied experiences, to advise on particular matters connected with individual workshops; for although, as in this article, general broad principles can be laid down, yet each separate case calls for special arrangement and consideration, which can only be determined by a thorough investigation of the nature of the shop and machines to be driven. This the officials, as a rule, are able and willing to do, and they will make many useful suggestions which will materially assist in making electrical power both a practical and a financial success.

It is quite certain that in most districts electricity for power purposes can easily compete on the question of cost with either steam or gas, while for practical utility its position is unassailable, provided always that it is properly installed.

EQUIPMENT OF KING GEORGE DOCK, HULL.

A paper read before a joint meeting of the Liverpool Engineering Society and the Manchester Section of the Institution of Electrical Engineers recently, by Mr. L. Leighton, contained some interesting particulars of the electrical equipment of the King George Dock, Hull, which is the most recently opened large dock in the kingdom; the following is an abstract of his remarks:—

This dock was opened in June, 1914—an article, which remained unfinished, owing to the outbreak of war, appeared in our pages at the time—and was constructed entirely to the designs of the joint engineers, Messrs. T. M. Newell and R. Pawley, of the North-Eastern and Hull and Barnsley Railways respectively. The water area of the dock, which is shown diagrammatically in fig. 1, is 53 acres, and it is provided with a complete system of railway sidings for handling coal, timber, and general merchandise; with transit sheds on the quays, and a grain silo.

Electricity is adopted as the prime mover for the various appliances on the estate, the only machines not directly driven by this power being the coal hoists, coal conveyor, tipping gears, gate machines, sluices and warping capstans at the entrance lock. These machines are operated by hydraulic power, the pressure water being supplied from electrically-driven pumps.

The author believes that this is the first large dock in the country to depend entirely upon electricity as a prime mover.

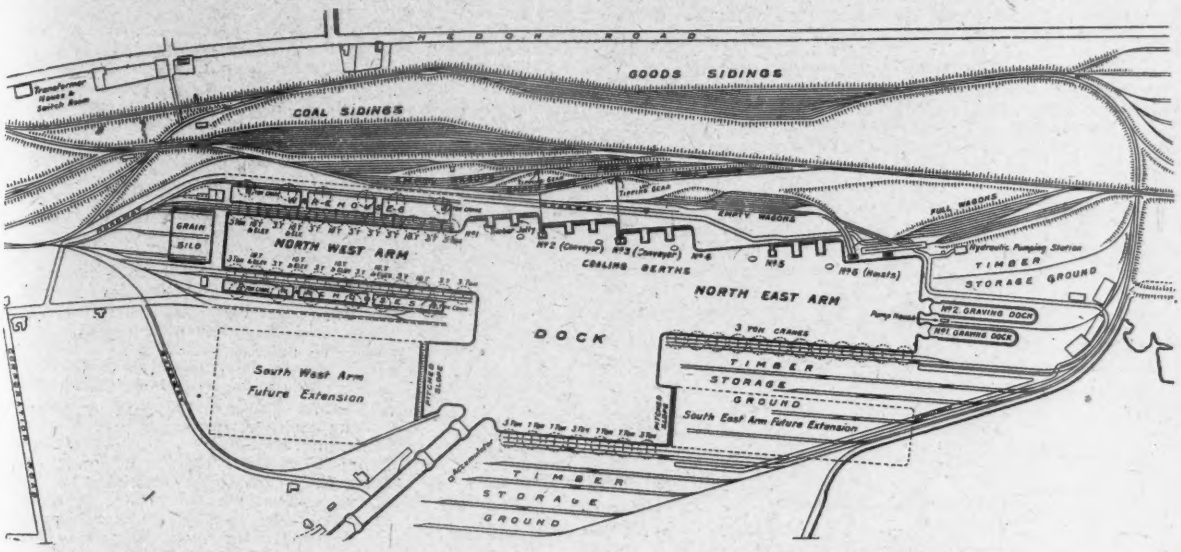


Fig. 1.—Plan of King George Dock, Hull, showing Position of Cranes, Conveyors, &c.

The speeds of working and horse-powers of the various motors are as follows:—

	10-ton.	3-ton.	1½-ton.
Speed of lift ...	50 ft. per min. (10-ton)	150 ft. per min. (3-ton)	250 ft. per min.
Do.	150 ft. per min. (3-ton)	250 ft. per min. (1½-ton)	—
Luffing speed at hook	100 ft. per min.	150 ft. per min.	200 ft. per min.
Revolving speed of hook (max.)	300 ft. ,,	400 ft. ,,	450 ft. ,,
Travelling speed on crane rails	30 ft. ,,	30 ft. ,,	50 ft. ,,
H.P. of motors—			
Hoisting ...	55	45	35
Luffing ...	15	8	6
Slewing ...	12½	5	6
Travelling ...	15	8	6
Elevator ...	15	—	—

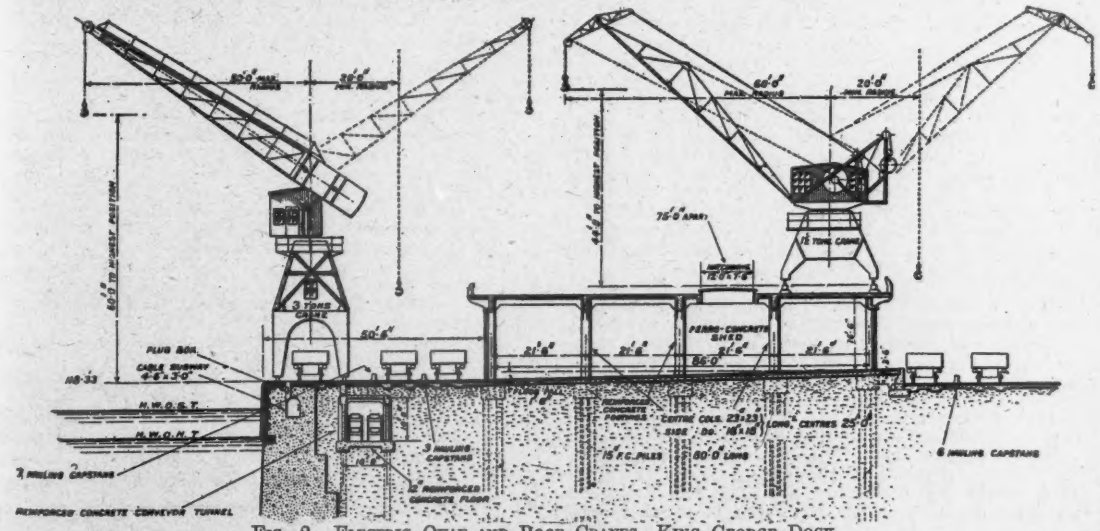


Fig. 2.—Electric Quay and Roof Cranes, King George Dock.

Three-phase current is supplied by the Hull electricity department at 6,600 volts to a special sub-station on the dock estate, built by the Joint Committee.

The equipment consists of 500-kw. motor converters, which transform to 440-460 volts, at which pressure direct current is supplied, through the Corporation's low-tension switchboard, to the bus-bars of the Joint Committee's switchboard, situated in the main switch-house adjacent to the sub-station, this board being operated by the Joint Committee. The lighting service is on the three-wire system, with a pressure of 440-460 volts across the outers, a balancing set being provided in the main sub-station for dealing with any out-of-balance load.

The quays and warehouse roofs are equipped with quick-working electric cranes, the principal dimensions being shown in figs. 2 and 3.

The cranes are all of the portal type with plated gantries, the quay cranes having clearance through the portals for the maximum railway load gauge.

Patent gears are fitted to all the cranes, so that the load moves in a horizontal path during luffing motions, in consequence of which there is a considerable saving in power and quicker luffing is permissible.

All the gearing is of machine-cut cast steel, with the exception of the motor pinions, which are of raw hide or compressed paper. Each motion is fitted with an electric brake, and in the case of the hoisting motion a foot brake is also provided on the barrel shaft for quick lowering without current, in which circumstance the electric brake is held off by a hand release arrangement.

The motors are of the totally enclosed type, six-hour rated, and work off the 440-volt D.C. circuit, current being conveyed to the cranes through armoured cable, from plug boxes connected to the mains, and fixed at intervals along the quays or shed roofs.

The switchboards are totally enclosed and fitted with voltmeter and ammeter, double-pole switches and single-pole overload and no-volt release circuit breaker, and fuses for the main incoming supply; the circuits to the various motions each have fuses and double-pole switches. Automatic cut-outs are provided as safeguards against over-running in either direction on the hoisting and luffing motions.

An interesting point in connection with six of the 10-ton cranes is that they are fitted with telescopic grain elevators, which, as will be seen from fig. 3, are carried by a supplementary jib at the opposite side of the centre post to the main jib. When not in use the elevators are derricked in to the centre and stowed in a vertical position. The elevators have a capacity of 120 tons of bulk wheat per hour, and are of the bucket type. They are driven by a separate motor, which, with the reducing gear and adjusting gear for the telescopic leg, is mounted on a platform at the head of the leg.

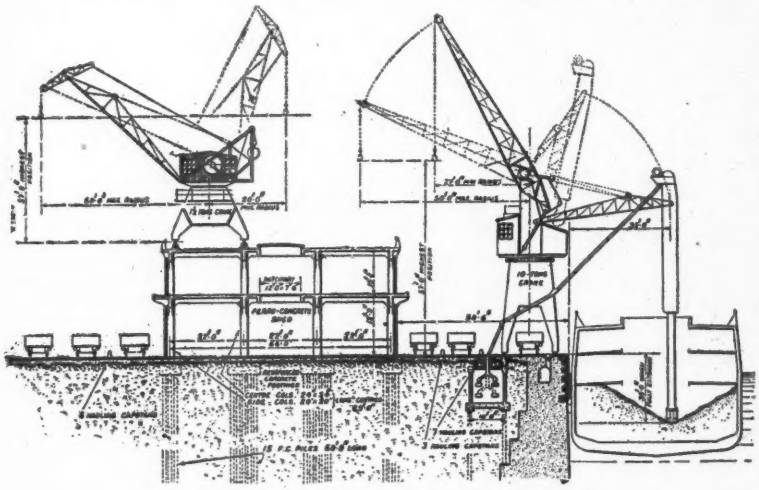


FIG. 3.—ELECTRIC CRANES, KING GEORGE DOCK.

To facilitate the handling of wagons 52 electric capstans and 88 rope fairleads are installed in convenient places between the railway sidings serving the various quays.

These capstans are of the self-contained turn-over box type, and are capable of hauling a load of one ton at a speed of 200 ft. per minute.

The motors are 18-B.H.P. totally enclosed, and one hour rated. The switchgear and starters are contained in an auxiliary cast-iron box fixed to the main frame, the starters being operated by a foot pedal.

A double-pole switch is fitted in an independent box in the line of the service to the machines. 26 of the capstans are fitted with automatic starters, while the other 26 have a centrifugal clutch, which does not take up the load until the motor has attained its full revolutions, the motor being started up under no load by a switch in the main circuit, operated by a solenoid in a shunt circuit, which is energised when the foot pedal is depressed.

In addition to the quay cranes a floating crane for maximum loads of 80 tons is provided. This is propelled by vertical compound condensing engines, the steam being obtained from a marine type boiler, but the lifting, slewing, and luffing motions of the crane, also the travelling counterweight, are driven by electric motors, supplied with current from dynamos which are clutch driven by one of the engines.

The output of the plant is 60 KW. at 220 volts, direct current; the Ward-Leonard control is adopted, all movements being operated by one man from a cabin placed on the revolving structure about 50 ft. above the deck.

The rails for the shed roof cranes are 20 ft. 7½ in. centres and extend for a length of 325 ft. at each block; they are bolted to timber way beams, which are supported by cast-iron chairs bolted to the roof. To enable the roof cranes to handle goods in the sheds five hatchways as shown are provided at each block, in the roof and first floor.

The sheds are effectively illuminated by clusters of metallic filament electric lamps fixed to the underside of the floor and roof slabs.

Special facilities are provided for dealing with grain traffic, consisting of a granary on the west quay of the north-west arm of the dock, having a storage capacity of 40,000 tons, built on the silo principle and equipped with all the most modern machinery for handling grain.

The granary is built in two blocks, each containing 144 storage bins.

Receiving houses are provided at the front of each block for housing the elevators, weighers, separators and other machinery. The fronts of the receiving houses, below cope level, are connected with a distributing chamber built below the quay and connected to the conveyor subways shown in figs. 2 and 3.

The conveyor subways extend for a length of 900 ft. at the North and South quays of the North-West arm. Two elevator legs mounted on the 10-ton cranes are provided at each berth, and deliver through pipes in the quay on to four conveyors in each quay subway, which deliver on to eight cross conveyors in the distributing chamber, fitted with movable throw-off carriages, which deliver on to any one of eight conveyors leading to the silo elevators, so that any one of the subway conveyors may deliver into any one of the silo elevators, for distributing to the various bins by means of eight conveyors placed above the bins and running the full length of the building. For the purpose of redistribution in the bins and for cooling off, the grain may be gravitated from the bins on to four conveyors fixed in subways under the silo, which deliver on to four cross conveyors in the distributing chamber, which in turn deliver to the elevators for returning the grain to the bins.

Four sack conveyors are provided under the sacking-off floor, capable of delivering at rulley slides for local distribution or of discharging on to four of eight conveyors running from the silo to the quay and supported on overhead gantries, for delivery to barges.

Travelling elevators, either of the pneumatic or bucket type, will be provided on the quay in front of the silo, for delivering grain from barge to the belts in the distributing chamber.

Twelve Avery automatic weighers of the latest type are provided in the receiving houses, together with 12 elevators for lifting the grain into the same, in addition to which there are eight elevators for lifting the grain to the top of the silo for distribution to the bins.

In addition to the main ship discharging elevators, six portable telescopic elevators, capable of discharging at the rate of 60 tons per hour, are provided. They are supported by beams spanning the hatchways and driven by electric motors and chain gearing. Portable conveyors working in conjunction with these elevators deliver, through spouts, to the quay conveyors or to the hoppers of Avery automatic triple weighers placed on the deck of the vessel and delivering overside to barge.

The conveyors, elevators and weighers have a capacity of 120 tons of bulk wheat per hour.

Each conveyor is fitted with screw tightening gear, and driven by a separate electric motor and a single train of machine-cut double helical gear.

The elevators are of the bucket type, and driven by electric motors through belting and a single train of double helical gear.

The electrical installation consists of completely equipped switch boards, mounted in a special switch-room. For controlling the main incoming supply there are two panels, and for the various power circuits ten panels, each panel being equipped with a circuit breaker and ammeter. The total aggregate brake-horse-power of the motors is 1,546.

The cables from the switchboard to the distribution boards and sub-boards are V.I.R. lead covered and armoured; between the distribution boards and starters and motors they are taped and braided and run in conduit.

The motors are totally enclosed and dust-proof and rated for continuous running. Each motor has a dust-proof iron-clad type starter equipped with starter, circuit breaker, and ammeter.

The buildings are lighted by metallic filament lamps in well glass or bulkhead fittings.

A complete system of automatic lever type inter-communication telephones is provided in the buildings and along the quay subways, also special alarm hooters for use in case of any stoppage or breakdown of the machinery. A one-ton electric lift is provided in each receiving house.

(To be continued.)

Belfast Electricians' Wages.—The Committee of Production, having considered an application for an advance of wages made to the Electrical Contractors' Association of Belfast by the Electrical Trades Union, have decided that the men shall receive 5s. per week and boys and youths 2s. 6d. per week, these to be regarded as war advances. Pieceworkers, premium bonus workers, and others paid by results are to be paid 5s. per week over and above the week's earnings, calculated on the present basis.

THE VOLTAGE REGULATION OF ROTARY CONVERTERS.

At a meeting of the Yorkshire Local Section of the Institution of Electrical Engineers on March 21st, at Leeds, Mr. G. A. Juhlin read his paper on the above-named subject.

Mr. J. H. Shaw said that many rotary converters had been installed with a large voltage range, which was quite unnecessary. On the other hand, the author's point with regard to large power factors on light loads did not count much with a large system. Take a railway company with a few trains per hour. The load on one sub-station might be very high when that on another sub-station might be low. In various circumstances rotary converters were not very suitable for a large range of voltage. He thought that a point which Mr. Juhlin had not brought out was that the rotary converter with a fairly large voltage range and purely shunt control could be satisfactorily designed, because the increase in voltage and operation was under hand control, and the commutating pole strength could be brought up, whereas the machine that was working on traction, perhaps over-compounded, was automatic. Another point was that power-factor correction on traction was utterly impossible. The load varied so quickly that it was impossible to follow it.

Mr. Christianson said it seemed to him that the booster method was inapplicable to traction for railways or tramways where the load was rapidly varying, because the operators could not follow the variations necessary in their rheostats. The reactance control was beautifully simple, and undoubtedly, from the operator's point of view, the ideal one. The machine simply acted like a pure shunt generator, and the operation was so like that of the ordinary generator that he thought many assistants in sub-stations thought that it just acted the same as the generator did. Referring to the trouble of flashing over on traction systems in the event of a short circuit, he would like to know whether there was any great difference between the flashing-over propensities of the booster-control machine and the reactance-control machine.

Mr. W. L. Browne said he thought that where the voltage variation was only small, reactance control was the best. His rotaries were inverted, and he did not quite see how to control the power factor in the case of the inverted rotary by the method which Mr. Juhlin had described; nor had he yet got very good control over the voltage when running inverted. He would like the author to say to what extent the voltage ratio might be altered by varying the design of the poles. He noticed that the minimum wattless current was got with a reactance of about 20 per cent. Ought the customer to ask the maker for a reactance value of about 20 to 25 per cent. in each case, or was it a point which the maker would put in for his own ends, and not look at it from the customer's point of view? He wished to know also whether the change of tapping could be done whilst the machine was on load.

Mr. Selvey said that such difficulty as he had with rotary converters had not been due to voltage regulation, but to the flux of the interpoles and their spacing, and that was a very important matter, especially on quickly varying loads.

Mr. Juhlin, in reply, said with regard to power factors on light loads, it was quite true that on a large system the total load did not change to the same extent as the load on the converter; but, even then, if the system had a big number of converters on it—as was the case with a number of the larger towns which ran their own tramway systems as well as lighting and power—there was certainly a considerable peak on the system due to the traction load, and, correspondingly, a reduction in the load when the traction peak was small. Mr. Shaw had wished the point to be emphasised that booster-control could be used with large shunt machines and over a considerable range, owing to the fact that it was possible to change the excitation on the winding of the interpole. If the load variations were slow that was perfectly true, but if the loads were rapid the matter became rather difficult. As to the question of power-factor control on a system operating on traction load, there was no difficulty in changing the power factor provided the booster was used, even on the traction system, as they could arrange the booster with a series field, which would take care of the changes required in voltage. At the same time a shunt field could be used on the booster, which would be required to compensate for any change in power factor on the rotary. So it was possible to vary the power factor on the traction system by means of the rotary, provided the booster was used. On main traction systems it was quite unnecessary to do so, because the power factor, as a rule, was sufficiently high without any correction. Mr. Christianson had raised the question of booster-control on traction systems; it was perfectly applicable, as they could use the series field on the booster. It was true that some sub-station attendants regarded the rotary more in the light of a D.C. machine than anything else. That point of view was fatal to the good operation of the converters, and ought to be combated by every possible means, because it was only by clear appreciation of the rotary as a machine that they could get really good operation. The question of flashing over was, naturally, bound up very closely with that of commutation; a machine which was operating under adverse conditions in regard to commutation would flash over more readily than a machine which commutated really well. It was generally more difficult to get good commutation on the booster type of machine. In considering the inverted rotary, it must be remembered that they could only get a certain range of voltage regulation on that type, and that could only be obtained by changing the wattless current from the rotary on the synchronised sets running parallel with it. Very low reactance in the transformers was required when the machine was running inverted, in order to get wattless regulation. With regard to the extent of regulation by changing the shape of the poles, it was possible to get a considerable range by the "split-pole" method. As for simply changing the shape of the main poles, it depended largely upon the individual design of the converter, but the range was very small—only, possibly, a few per cent.; very limited indeed. The customer should specify clearly the range of voltage required and the conditions as to power factor required on the high-tension side of the transformer. With these conditions given, the manufacturer should have free choice as to the reactance which he considered most suitable. If the customer specified for the reactance as well as the power factor of the system, it left the manufacturer very little choice in designing. Changing the taps on the transformer so as to give different ranges could not be done except where they could shut the machine down, unless a booster-transformer was used. The conditions which he had based his points on in that connection were that they had two ranges, one for general lighting and power work, and the other for traction, in which case the machine need not necessarily be shut down. Mr. Selvey had raised a question as to the spacing of the poles, which, of course, was a point of considerable importance, especially in low-voltage machines, and it had received very careful consideration by manufacturers as a whole. A point of very great importance in Mr. Selvey's remarks was that they should arrange machines for a given service, and he believed that in a number of cases where lighting and power work was done, as well as traction, a certain number of rotaries were used purely for general power work and lighting, whilst others were used exclusively for traction. In such cases the machines were not only cheaper, but better running conditions were obtained with them. If a large range was required, it was quite clear that the rotary was operating under adverse conditions, as it was normally a machine for fixed voltage. That point, to his mind, was one which should receive the most careful consideration by operating engineers and others who had to specify for rotary converters.

Mr. Juhlin's paper was read and discussed at a meeting of the Scottish Local Section at Edinburgh on March 20th.

Mr. W. B. Hird, in a communication, pointed out that in cases such as that mentioned in the paper where two different ranges of voltage were required, it seemed self-evident that the use of two tappings on the transformer had such great and immediate advantages that one would expect it to be universally employed. By reducing the range of regulation required from the reactance, the booster, or whatever other method was employed, it evidently simplified and very much cheapened the first cost of the apparatus required. It would seem, however, that for the fine regulation required in addition to the tappings, there were other methods worthy of consideration. One of these was the use of a D.C. instead of an A.C. booster, and although the difficulties of designing a suitable commutator for such a machine might in some cases be prohibitive, there must be many cases in which the D.C. booster would give an ideal method of regulation. It would be free from the objections to the reactance method in that it would give a greater range of regulation, and would allow of control of the power factor. It was true that if connected with the rotary shaft it would still introduce increased difficulties in the commutation of the rotary in the same way as described for the A.C. booster, but it was quite conceivable that cases would occur where it would be possible and convenient to employ a motor-driven D.C. booster. Another method of theoretical interest would be the use of a reactance in the line, so that the amount of reactance could be varied at will. Such an arrangement, if found possible in practice, would do away with some of the difficulties now experienced in the use of voltage control by reactance.

Mr. Belsey emphasised the necessity for the purchaser or the operating engineer to look very closely into the limits of voltage that might be required. If there was a little more sympathy between the designer and the purchaser it would be greatly to the benefit of both sides. While the induction regulator had not been much used in this country, it had, he thought, been a success in the United States.

Mr. Roer pointed out that in many cases they had found that machines with a large range were never run to their highest limits, with the result that the customer had to pay for a larger machine—one that was more expensive and not so efficient as if the range had been confined to smaller limits. Referring to the motor converter, he remarked that due to the higher reactances which these machines had on low loads, the wattless current taken on the low loads was

considerably smaller than with the corresponding type of rotary converter.

Mr. Arch. Page said that he was associated with the Glasgow T.C. electricity undertaking, in which there were at present 97 rotaries carrying 53,000 kw., and they had only half a dozen booster controlled rotaries out of that 97. They had, however, a number of motor generators—34 with 24,000 kw., and one motor converter of 1,000 kw., a total altogether of converting plant of approximately 79,000 kw. For the last two years their specifications for rotaries had hardly varied at all. They got sufficient regulation from their resistance controlled machines, but they did not go the length of asking 7½ per cent.—they were content with 4 per cent. either way. That, he believed, was probably more than sufficient; in fact, when there was a fair number of substations dotted all over the system, he thought that 2½ per cent. would be sufficient to meet the average case. He would put the cost as probably the most important item, with commutation second, power factor third, and range of voltage in the fourth place. Efficiency required consideration, but as all these properly designed and constructed machines were more or less of equal efficiency it did not amount to very much. Maintenance was, however, distinctly against the booster type. There seemed to be quite a lot of trouble over interpoles, and he described an experiment on an automatic method of changing which was proceeding in Glasgow. This consisted of a double set of brushes, and rather a complicated set of brush gear. The one set led through the synchroniser to the lines, and the other set led through the commutating pole windings, with the result that if the adjustment was correct they got the effect desired. They had also persevered with high output machines, and they were now able to buy these high-speed machines, and get very successful results from them. He asked Mr. Juhlin if he could explain the excessively high open-circuit l.t. voltage one sometimes got with a transformer built specially for rotary-converter work. He found an open-circuit voltage of about 600 volts instead of what one would expect—370 to 400.

Mr. Seddon said the object of the paper appeared to be to point out the value and simplicity of reactance control when a voltage regulation of not more than 15 per cent. was required on the d.c. side. Up to this point a rotary converter was a comparatively simple machine, but, if an increased regulation was desired, then the rotary did not appear to be quite so simple as was claimed. There were many ways of effecting this increased regulation, and he believed that most engineers were agreed that, from an operating point of view, the synchronous motor-generator was the ideal machine; it gave them all the regulation that was required in practice, and the power factor was under complete control, though, unfortunately, its efficiency was low. On the other hand, the simple rotary converter had poor regulation, but its efficiency was high. He thought the case could be met by the motor converter.

Mr. Whysall said that in Greenock they had carried out their extension on the lines advocated by the author. All their rotaries were of the reactance-control type, six-phase converters (with the exception of one 75-kw. inverted rotary, with which was a d.c. booster). In the case of two rotaries they had a middle-wire booster introduced for balancing purposes on a three-wire lighting system. In his opinion, the reactance-control type of rotary was the most suitable provided the conditions were such that the voltage regulation would come within the range of the 15 per cent. mentioned in Mr. Juhlin's paper. Their voltage regulation was carried out satisfactorily, and a variation of about 10 per cent. was all that was necessary under normal working conditions. Two-thirds of the machines were installed on consumers' premises for two-wire working with a d.c. voltage range of 200-240 with level compound characteristics, the compounding effect being necessary on account of the very heavy intermittent loads with the service required. He referred to shipyards and engineering works using 200 to 250-h.p. air compressors accelerated from standing to full load within 20 seconds and automatically controlled. The voltages on the lighting and traction systems where the rotary converters were used for either service were 500-560 volts on the outers for lighting, and 540 volts for traction, so that no a.c. boosters were required; 2½ per cent. tappings were left on the h.t. side of the transformers to enable the same range to be got at lower or higher voltages, say, 480-520. The higher range was only required during the winter months, and little trouble was involved in changing from one set of tappings to another at the beginning or end of the season. There was a tendency to over-excite the fields of the rotaries under the reactance control with the intention of improving the power factor to compensate for the wattless currents which might come from other parts of the system, and experiments had demonstrated that the heating of the near tap coils on the armatures of six-phase rotaries had been so great, more especially on overloads at leading power factors, as to make it rather a risky proceeding. The inherent good voltage characteristics of converters were at times rather embarrassing, especially when feeding into a heavy fault, or endeavouring to parallel with the d.c. network at nearly full voltage after a shut-down. In this connection, it had occurred to him that with lower voltage and frequency concurring simultaneously trouble might be caused due to resonance being set up on the circuit.

Mr. Hinings gave the opinion that one disadvantage of the reactance-control rotaries not mentioned by the author was the question where the shunt field rheostat should be fixed. If it was fixed adjacent to the a.c. control panel of the machine for ease in synchronising, it was in the wrong place for d.c. regulation, as usually the a.c. and the d.c. controls were some distance apart. When two rheostats were fitted, one in the a.c. and one for the d.c. panel, the length of the field connections of the two rheostats formed a possible source of trouble. With booster control the main field rheostat was fixed adjacent to the a.c. panel for ease in synchronising, whilst the booster field rheostat was fitted near the d.c. voltage control.

Mr. Juhlin, in reply, agreed with the necessity for closer co-operation between the manufacturers and the purchaser. There was no question that the induction regulator was very useful for voltage regulation of rotaries. The usefulness of the reactance in the case of heavy overloads was a point which required consideration from the operating engineer. They had no other means of varying the voltage of the motor-converter than reactance control, while, further, they had in the motor-converter the question of the magnetising current. They had in the motor-converter, as in the rotary-converter, a fixed ratio between the voltages, whereas in the motor-generator set they had absolutely independent control. There was no difficulty in getting transformers with 25 per cent. reactance; in fact, larger ranges could be obtained. There could be no rise in voltage except where a fairly heavy wattless current was being carried. The rotary getting out of step and surging was due in many cases to high drop in the feeders, which might be accentuated in the case of surging. In Mr. Whysall's description of the system he was operating it was interesting to find operating engineers who considered it little trouble to change over the transformer; if used, it would mean a considerable lessening of the difficulties in connection with voltage variation. As a general rule they had to go to very much larger systems than were prevalent in this country to find resonance conditions.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electricity Supply Rates and Government Contracts.

Now that the War Office and other Government Departments are taking electric supply in every part of the country for offices, works, hospitals, camps, &c., electricity undertakings are faced with the usual formal requests for special terms, and are sometimes rather in a dilemma on what principle to act, in view of the argument that the supply is wanted for national purposes, and, as such, entitled to special consideration. But, looked at correctly, the decision is really taken out of their hands by Act of Parliament. In the Electric Lighting Act, 1882, it is enacted that the undertakers shall not "show any undue preference to any local authority, company, or person." Corporate bodies or Government Departments are, therefore, as clearly debarred from preferential treatment as any private consumer.

The course laid down is obviously quite clear, namely, that there must not be made to any Government Department any reduction from the standard rates beyond that which is warranted by the conditions under which supply is taken (maximum demand, hours of use, &c.), or, in other words, Government Departments must be treated on all fours with all other consumers.

Of course, where there is a case where a patriotic feeling might naturally come to the fore, say, in the case of hospitals, &c., it is clearly the more advisable course to keep strictly within the Electric Lighting Act, and to give, say, a donation to the hospital, or help in any other way, quite independently. It amounts to the same thing in the end, and no principle is violated, and no improper precedent formed. Further, if undertakings took this course, it would mean consistency of action throughout the industry.

Electric Supply.

The Controller Drum.

Referring to the article under the above heading appearing in your issue of 16th inst., it appears to the writer that there is an even more important point in the arrangement of controller drums, which does not appear to be generally recognised by the designers.

This is that the field windings of the motor, whether shunt or series-wound, and especially, of course, when not provided with any "kicking" coil or "discharge" resistance, should be so connected to the controller that interruption of the current when "switching" off will leave the field windings isolated from the controller, motor armature, &c.

Unless this is done, such apparatus is needlessly exposed to the inductive rise of voltage which occurs when the current in the field windings is interrupted.

In the diagram shown in the article in question it is evident that both the magnetic blow-out coil and also the

controller resistances are thus needlessly exposed to this strain, and, in consequence, more liable to breakdown of insulation.

It is not possible by examining the diagram to say whether or not other parts of the apparatus (the armature of the motor, for example) are thus affected. It depends upon the point in the controller at which interruption first occurs.

The field connections, whether shunt or series, should be brought through corresponding contact fingers to two separate bars, which, to ensure the circuit being opened at the right points, should be made slightly shorter than the other bars.

The writer has come across several instances of breakdown of insulation of series-wound crane motor armatures from this cause.

In such cases, of course, interruption of current is frequent and very rapid, thus causing considerable inductive rise of voltage even in the case of series-wound field coils.

Norman J. Hockley.

Manchester, *March 22nd*, 1917.

Oil-Immersed Circuit Breakers for Use on Continuous Current Supplies.

As there appears to be some considerable diversity of opinion as to the suitability of oil-immersed circuit breakers on continuous-current supplies, I take the liberty of writing you to inquire if you would care to take this question up with your readers. Doubtless some of them have had experience with gear of this nature on D.C. systems, the results of which experience they may be pleased to make known.

G. G.

March 22nd, 1917.

Linking-up with Waste Heat Stations.

I understand that several of the large electric power companies have linked-up their generating stations with smaller power stations using waste heat from coke ovens and blast furnaces. I should be much obliged to know if any of your readers have heard of municipal or company undertakings linking-up with factory generating plant where the exhaust steam from the engines or turbines is utilised for a heating or evaporation process in the factory.

Central Station.

Greenock, *March 22nd*, 1917.

Women and "Shorts."

With regard to the controversy *re* above at Marylebone started by "Exciter" some weeks ago, we understand that the Chairman (Mr. Duncan Watson) has been making investigations among the employés of this Corporation electrical department with a view to ascertaining the originator of this article, in order, we believe, to mete out justice accordingly.

We think it only fair to state (for the benefit of the staff concerned) that we were not, and are not, employés of this Borough Council.

Exciter.
Booster.

Fault Localisation.

I should be very glad if any of your readers could suggest an accurate method of locating a fault under the following conditions:—

Tramway feeders, V.I.R. double taped and braided, 1 sq. in. section, in duplicate, laid solid in wood troughing, with bitumen. Both cables shorted and earthed.

Any of the ordinary tests were of no use, varying nearly every time.

On finding the fault, both the feeders were found to be burnt out completely for a distance of about 6 in.; carbonised bitumen between them, and between them and earth, had been the means of carrying the test currents.

A. Sommerville.

Ayr, *March 26th*, 1917.

WAR ITEMS.

Marylebone Electricity Staff and National Service.—The Marylebone B.C. Electricity Supply Committee reports that it has considered the question of employés enrolling under the National Service scheme. Owing to the fact that the staff of the department has now been reduced to the absolute minimum, and to the importance of the work being done by the department, and the urgent necessity, being the public lighting authority, for maintaining an efficient lighting service, the Committee has directed the general manager to inform the employés that as they are already engaged on work of national importance they should not, for the present, enrol under the scheme.

Westinghouse War Relief Funds.—We have received a copy of the British Westinghouse Employés' War Relief Fund which was submitted at the meeting of delegates held at the British Westinghouse Club, Moss Road, on Friday last. The contributions by employés down to December, 1916, amounted to £24,529, and those by the company to £11,391; other income brings up the total to £36,394. There has been paid to dependents £20,584, Christmas gifts amounted to £1,204, donations to local and national funds £834, and after meeting sundry expenses there is transferred to Disablement and Dependents' Fund £11,235, the balance being £2,294. The fatalities to date number 168, but it is impossible to estimate what the increase therein will be in future. It is estimated that £14,000 invested at 4 per cent. would be sufficient to pay 5s. per week to 200 families for five and a half years. Therefore, it is necessary not only to conserve the present balance, but to augment it in readiness for probable further losses.

The Unruly Member.—A night scene at the Central Electric Co.'s works in Lodge Road, St. John's Wood, was described at the Marylebone Police Court recently, when George Dellar, a pensioned quarter-master in the Navy, living at 61, Wharncliffe Gardens, was summoned before Mr. Paul Taylor for assaulting Charles David Brodie, a skilled electrician at the power station, living at 63, Wharncliffe Gardens. Mr. F. Freke Palmer, solicitor, supported the summons, and explained that Mr. Brodie was a man of 28 years of age, who was badged by the Minister of Munitions in consequence of the responsible position which he occupied at the electric power station—a certified undertaking under the Munitions of War Act. He had twice offered himself for service, but had been refused on the ground that he was engaged in his present employment on work of national importance. For some months, however, he had been greatly annoyed by the defendant's wife, who taunted him with living in a funk-hole, and after he had remonstrated with her about it, her husband visited him at his work and committed the assault complained of.

Mr. Brodie, giving evidence, said he was in charge of a switchboard at the power station. He attested under Lord Derby's scheme, and had twice offered himself for service, but was refused on the ground that he was doing better work where he was. Mrs. Dellar had been offensive to him, and on March 6th he spoke to her about it. Next night, while he was at work at the power station, she called there, and when he went out to speak to her her husband stepped from behind, made some remark about insulting his wife, and struck him on the side of the mouth. He also swore, and his wife shouted as loudly as she could: "Two and a half years in a funk-hole; two and a half years a slacker, slacker, slacker."

Mr. H. P. Gaze, executive engineer at the station, stated that Mr. Brodie had been there 12 years, and was a highly skilled man occupying a very responsible position.

Mr. Paul Taylor said he regarded it as a very serious matter. Mr. Brodie was serving his country, and no doubt he was doing good service as a skilled electrician at the power station. The defendant, however, had done a positive disservice to his country, and, but for the fact that he had not abused Mr. Brodie, he should not have hesitated to send him to prison without the option of a fine. Anything more outrageous he could not understand. It made one despair of the stupidity of some people. Husbands were supposed to be able to keep their wives in order, though it was difficult, no doubt, to keep a woman's tongue in order. He fined the defendant 10s., with 21s. costs.

Ministry of Munitions and Electric Lamp Glass.—The Ministry of Munitions has issued the following regulations:—

(1) No person shall manufacture any electric lamp glass unless the purpose for which such glass is required has been approved. Such approval must be evidenced by one or other of the following, which must be quoted by the ordering firm to the manufacturer, together with the purpose for which the glass is required:—

(*a*) Reference to and number of an Admiralty, War Office or Ministry of Munitions contract for which the glass is necessary; or

(*b*) A certificate authorising the supply issued on behalf of the Minister of Munitions by the Director of Optical Munitions and Glassware Supply.

(2) Manufacturers of Electric Lamp Glass are required to render to the Director of Optical Munitions and Glassware Supply at regular intervals full and accurate returns of their manufacture and output of electric lamp glass in accordance with the directions from time to time given by the said Director.

(3) No person shall buy, sell, or deal in any electric lamp glass situated or to be manufactured outside the United Kingdom unless a certificate authorising such purchase, sale or dealing has been issued on behalf of the Minister of Munitions by the Director of Optical Munitions and Glassware Supply.

(4) For the purpose of this Order Electric Lamp Glass shall include all glass intended for use in the manufacture of electric lamps except glass used or intended for use in lamp caps for insulating purposes, but shall not include glass shades and similar accessories.

(5) All applications in reference to the above Order should be made to the Director of Optical Munitions and Glassware Supply, Ministry of Munitions of War, 117, Piccadilly, W. 1.

Exports to China.—Further additions to the list of persons in China and Siam to whom exports may be consigned appear in the *London Gazette* for March 27th.

Exemption Applications.—Conditional exemption has been continued in the case of Mr. W. J. Oxenham, 29, married, "A," engineer and manager for the Launceston and District Electric Supply Co., Ltd. It was stated that Mr. Oxenham and the engine driver were practically the only ones left. Six months ago a disabled soldier was engaged, but he left, and since then Mr. Oxenham had had to attend to the switchboard in addition to his other work. They were unable to get a switchboard attendant to relieve him. If Mr. Oxenham went the town would be in darkness.

At Rotherham, a switchboard operator, aged 18 and passed for general service, engaged at the Corporation electricity works, was appealed for by Mr. Lilliker, who said that it was impossible to get a substitute. Two months were allowed, and conditional exemption was conceded to an employé, aged 39, engaged on repair work at the electric light station, who averages 84 hours' work per week.

At Wrexham, the Military appealed against conditional exemption held by G. Steen (35), chief inspector to the Wrexham Tramway Co., in Class A. The manager, Mr. Hawkins, said that the cars carried 7,000 miners weekly, and the pre-war staff of 82 had been reduced to 35, only three of whom were of military age. Exemption until May 13th, subject to substitution, was the decision.

At Cowes (I.O.W.), the Isle of Wight Electric Light Co. appealed for A. C. Long (22), shift engineer, passed for general service after being placed in Class B 4, equivalent to C 1. The Chairman said they were prepared to admit that the man was of the greatest importance to the company, but, having regard to his age and Class, they could grant only two months' final exemption. Leave to appeal was granted.

On the appeal of the Military, the Lewes Tribunal has cancelled conditional exemption held by J. Morris (30), clerk, &c., with the Lewes Electric Supply Co., who asked for the exemption to be continued. The certificate was withdrawn, a month being allowed.

At Falmouth, an appeal was made by Mr. F. E. Deeble (26, in Class A), electrical engineer, who has sole management of his father's business in Arwenack Street. He stated that he was contractor to the naval authorities, and had been badged. In reply to the Military Representative, he said that he served for six years in the Electrical Engineers Volunteers, and applied for his discharge 10 months before the war broke out. The application was refused, with a month's grace.

Mr. Fergusson, tramway manager at Dartford, appealed for three drivers and repairers, and a fourth repairer, and produced a telegram from the Ministry of Munitions calling attention to the importance of maintaining the system. One was refused exemption, and the others were conditionally exempted.

At Doncaster, an appeal was made by the Corporation tramway department for the car-shed foreman, who, Mr. E. S. Rayner, manager, said was the only skilled man left at the sheds. They had lost 80 per cent. of the staff, and had the greatest difficulty in keeping the cars running. The Chairman: Do you put it as strong as to say that you could not carry on if this man went? Mr. Rayner: The service would have to be cut down until we could get another man of equal merit; we could not keep the shed running. Exemption until May 31st was given.

Clacton-on-Sea Tribunal has cancelled conditional exemption held by an employé at the U.D.C. electricity works, aged 28, and four weeks' grace was given. The manager stated that he could not get a substitute.

At Hythe (Kent), Mr. T. Hesketh, manager of the Electricity Supply Co., Ltd., appealed for Mr. A. C. Wampach (38), the company's electrical engineer. He said that he appealed as a matter of necessity and in the national interest. They required for the work in hand many more men, but it was utterly impossible to get them. If Mr. Wampach had to go, the Hythe works would have to be shut down. The company was under contract to supply current to the military. The Tribunal allowed three months.

Conditional exemption has been given to Mr. J. T. Jones (25, in Class C 1), manager for the Oswestry Electric Light Co., Ltd.

At Aldershot, the Traction Co. made appeals for a driver and fitter (37, general service), a fitter (34, C 1), and a foreman fitter (39, general service). Asked which was the most important, the night or day staff, Mr. Eggar said that both were of equal importance. If the night staff could not get their work done the day services could not run. The Tribunal decided that the company ought to be protected, and each man was given three months.

At Southend-on-Sea, the borough electrical engineer appealed for 12 tram drivers, aged from 30 to 40, seven passed for general service, four in B 1, and one in C 1. Mr. Birkett asked for as long delay as possible so that women could be trained. Seven of the men were given until May 1st, two until June 1st; and the others had conditional exemption.

At Bridlington, Mr. Ffrench, borough electrical engineer, appealed for a mechanic and stoker at the electricity works, and said that he must have a qualified man. The Military Representative said that he would see that a substitute was provided, and this was assented to, a month's respite being given.

An appeal was made at Peterborough for C. W. Armitage (29, passed for general service), foreman with the Tramway Co. The Chairman said that there could be no exemption as their instructions were to send all men under 31 and in Class A.

Kidderminster Tribunal has refused exemption to a tram driver, appealed for by the Electric Traction Co. In reply to a question, the manager said that they had not yet tried the experiment of women drivers.

An appeal was made to the Esher and Ditton Tribunal for exemption for the head electrician engaged at the Royal Mills, Esher, and he was given until June 1st.

At Windermere, the Military appealed against exemption until June 1st granted to Mr. L. Birkett, of the staff of the Electrical Supply Co. The exemption was continued, but the Military Representative warned the company that Mr. Birkett would not be further exempted, and that they should provide a substitute. The Military also had reviewed the case of J. Reed, of the company's staff, called up under the new order as to men under 31. He was 31 before March, 1917, and, on the Military assenting that he was in a reserved occupation, conditional exemption was agreed to.

At Barnsley, Mrs. Burns appealed for B. Gregory (23), electrician, the only man left to assist her in the business. She said that she had failed to get anyone to replace him, and, on the suggestion of the Mayor, it was decided to refer the case to the substitution officer to find a substitute.

On the appeal of the Urban Electric Supply Co., Walton-on-Thames Tribunal has granted two months' exemption to J. Wheatley (24), electric wireman, in Class C 2.

At Doncaster, the tramways department, through Mr. E. S. Rayner, the tramways manager, appealed for a car-shed foreman and a driver. Mr. Rayner said it was impossible to replace the foreman. They were having difficulty in keeping the cars on the road, and great trouble in getting materials. It was impossible to get skilled labour. The department had lost 80 per cent. of its men. The bulk of the passengers were munition workers. Postponement to May 31st was allowed. The driver was granted a similar, but final, period.

At Ilkley, an application for conditional exemption was made by a consulting electrical engineer, aged 33, married, who had been exempted for four months to allow him to devote time to experimental work on a patent electrical motor. He said the work had been completed, and the motor placed on the market, and was now being used for Government and munition purposes. He was devoting part time to munitions, and the remainder to the commercial side of his patent. He desired exemption to enable him to apply for a badge. The case was adjourned for a fortnight in order that he might apply to the Ministry of Munitions for a badge.

The Heckmondwike District Council's electricity department applied on behalf of an engineer's clerk and shift engineer, aged 21, and unmarried, and two junior shift engineers, aged 18 years, all being Class A men. The Military Representative admitted having to recognise the importance of the maintenance of public services, but he said one of the men concerned was engaged chiefly on clerical work, and, he thought, might be replaced by a girl. The three claims were disallowed, provisionally on substitutes being found.

The Batley Corporation electricity department applied for reconsideration of cases heard in the previous week. The Electricity Committee doubted whether the whole of the facts had been placed before the Tribunal, and the Chairman (Coun. F. W. H. Auty) attended to ask for a review. He said the three men particularly concerned were A. Russling, aged 23, single, station superintendent, who had been given till May 1st; J. Ainscough, 36, married, shift engineer, disallowed without grace; and R. J. Greenwood, 19, single, junior engineer, grace till May 1st. If these decisions were allowed to stand, said the Councillor, the electricity works would, at May 1st, be left with one driver and no shift engineer. The Chairman of the Tribunal said Ainscough's case had been refused because he was leaving the works. Coun. Auty said it had been thought they had power to keep him, but they found on inquiry that they had not, and that was the reason why they had lost their chief assistant. Ainscough, however, was now willing to stay at the works. Even with Ainscough remaining they would only have three shift engineers, whereas they ought to have four. If Ainscough had to go and another man could not be got, it would be a big step nearer shutting up the works. The engines could not be kept going without shift engineers. Eventually it was decided that Ainscough should have conditional exemption, but, in view of the urgent demand for men under 31, the Tribunal could not alter the decision as to the other men. The Electricity Committee must do its best, in six weeks, to replace Greenwood and Russling.

All Hands to the Plough.—According to the *Sheffield Daily Telegraph*, Mr. S. E. Fedden recently communicated with the Board of Agriculture, offering the services of the staff of the Sheffield Corporation electricity power stations as volunteer ploughmen in their spare time. It appears that the men will be motored to farms in the evening, and will do night ploughing with motor-ploughs to be provided by the Board of Agriculture, and at week ends they will engage in general work on the land.

LEGAL.

British Thomson-Houston Co., Ltd., *v.* Duram, Ltd.

The Court of Appeal, composed of the Master of the Rolls and Lords Justices Warrington and Scrutton, delivered judgment, last week, in this case upon the plaintiffs' appeal from a judgment in favour of the defendants.

The Master of the Rolls said that he had had an opportunity of reading the judgment about to be delivered, and agreed with the conclusions arrived at by the learned Judge. He was of opinion that the judgment of Mr. Justice Astbury should be affirmed, and the appeal dismissed, with costs.

Lord Justice Warrington said the first question was to determine what was the true construction of the specification, in order to ascertain what was the invention described and claimed. Tungsten was one of the refractory metals, was ordinarily in the form of a finely-divided powder, and had a very high melting point—viz., somewhere about 3,000° C. It could only be melted by the employment of the electric current, and the product so obtained was apt to be a carbide of the metal, and so hard as to be of no use for purposes such as those for which a metal was commonly used. Prior to the date of the patent, however, means had been suggested—notably by Moissan, in 1896, and in a specification of Just and Hanaman, in 1904—for obtaining pure tungsten in a solid form. In Just and Hanaman's specification, the object aimed at was to obtain a filament of pure tungsten for electric lamps. In 1906 there had been no commercial application of any of these suggestions, but the plaintiffs' specification assumed that tungsten might be obtained in a solid form suitable for the application of the invention claimed in various ways, and the patentees described one of such ways, treating it as one already kown, and making no claim to it as an invention of theirs. Working a metal in the technical sense meant altering its shape in such a manner as to produce a spreading or extension of the actual metallic body. The expression covered and included the well-known processes of hammering, rolling, and drawing. Turning to the specification, his Lordship said the first claim with which it was necessary to deal was in these terms:—"The method of working tungsten which consists in subjecting the metal in a coherent form to the action of heat while it is being operated on or manipulated." Taken by itself that created no difficulty. The only special feature claimed was subjecting the metal referred to to the action of heat during the operation of working. This special feature was claimed as applicable to every mode of working, including hammering, rolling, and drawing; as to that, there was no dispute. The fight had ranged round the words "the metal in a coherent form." Did they mean, as the defendants said, any form of solid metal however obtained, or were they limited, as the plaintiffs contended, to a metal which had assumed a solid form only by reason of the coherence of the particles of which the original powder consisted? Reading the words by themselves, he should feel no difficulty in saying that they included any form of solid tungsten, the only form of the metal to which the process of working could be applied. But it was said that the specification afforded a context with reference to which the words must be read, and that if that was done it would be found that they bore the narrower construction for which the plaintiffs contended.

His Lordship, having read the material portion of the plaintiffs' specification, said that the patentee plainly applied his invention not only to a rod obtained as described, but to one "obtained by any other method which yielded a pure coherent product." He could not see that that meant anything less than pure metal in a solid form as distinct from powder. In his opinion, the context, so far from assisting the plaintiffs, tended to show that the patentee was dealing with the metal in a condition suitable for working, that was to say, not as a powder, and that he regarded it as perfectly immaterial how that condition was obtained.

Continuing, his Lordship said: The view which I have expressed as to the construction of the specification is, I think, supported by the extreme difficulty the plaintiffs' counsel found in stating in a consistent or intelligible way the limitation they seek to impose, and it was only in Mr. Walter's argument in reply that we got it in a definite shape, in substance corresponding with what he stated to be their contention. The claim therefore is, in my opinion, simply for the employment of heat during the working operation, whatever it may be, as a means of effectuating or facilitating that operation when the subject of it is tungsten. The patentees' condescend to no definite particulars as to the degree of heat, nor do they lay claim to any special form of apparatus for its application, or any special mode of applying it.

The so-called discovery seems to me to be no discovery at all, for it is proved that it is part of the ordinary routine of a metallurgist, if he has to deal with a metal which cannot be worked cold, to use heat to facilitate the operation, it being well known that the action of heat on a metal is to encourage the change of shape which it is the object of the working to produce. If the present patent were to be held valid, no person could during its subsistence follow this routine in the case of tungsten without infringing the patent. I am clearly of opinion that, construed as I think it ought to be construed, the specification neither describes nor claims an invention which can be the subject matter of a patent, and the patent is, therefore, invalid. It is unnecessary to deal with the question of anticipation or insufficiency of the specification. The appeal, in my opinion, fails, and must be dismissed.

Lord Justice Scrutton read a judgment also dismissing the appeal. He said he agreed with Mr. Justice Astbury's view that there was not sufficient subject matter in Claim 1; the subject matter, if any—the knowledge of the malleable and ductile quality of a metal under a well-known process—was, he thought, anticipated by Moissan. He could not think there was any patentable invention in applying to a new metal a method which any competent metallurgist would use if invited to report on the qualities of a metal of whose nature he was ignorant. That short point disposed of the case, and it was unnecessary to deal with the numerous other points that were raised in the defendants' arguments.

Pritchard *v.* Peto and the Electrical Contract and Maintenance Co., Ltd.

In the King's Bench Division, on March 27th, Mr. Justice Bailhache and a common jury heard an action in which a newsagent, of Packington Street, Islington, claimed compensation for personal injuries against Mrs. Peto, the occupier of a house in Packington Street, and the Electrical Contract and Maintenance Co., Ltd., when the question arose as to whether Mrs. Peto or the Electrical Contract and Maintenance Co., whose telephone line was fixed to the coping, the falling of which caused the accident, was liable. On April 16th, 1916, the plaintiff was calling at Mrs. Peto's house in the ordinary course of his business, when a piece of the cornice from the top of the house, without warning, fell upon his head, causing injuries by which he was confined to his bed for some weeks. The plaintiff's case was that the cornice was rendered unsafe by reason of the manner in which the telephone wire was fixed to it, and in this contention he was supported by the first defendant.

Mr. Langdon, K.C., appearing for the defendant company, contended that the telephone fittings had nothing whatever to do with the crack which had caused the accident, and, after a discussion, it was agreed that a surveyor should visit the premises and report, and upon that report the parties would take their stand, and accept any assessment of damages at which the jury might arrive in the meantime.

The jury accordingly assessed the damages at £100.

Mr. Elkington, who was the surveyor chosen, subsequently reported that after viewing the premises he came to the conclusion that the driving of the nail to hold the telephone triangle had nothing to do with the cracking or the accident.

Mr. Langdon, K.C., said that that exonerated the Electrical Contract and Maintenance Co., and he asked for judgment as far as they were concerned.

Judgment was accordingly given in favour of the defendant company, and, after hearing arguments, his Lordship reserved his decision in regard to Mrs. Peto, the other defendant.

NOTES FROM CANADA.

[FROM OUR SPECIAL CORRESPONDENT.]

There has just been published by the Commission of Conservation of Canada, a report on the water powers of Manitoba, Saskatchewan, and Alberta, which forms a sequal to a similar work, issued in 1911, called "The Water Powers of Canada." In the latter, the Eastern Provinces of the Dominion were pretty thoroughly covered, but as the information then available regarding the West was insufficient, it was not possible to treat the subject other than quite cursorily.

It is evident from the report under review that the Government is doing a work which will some day prove extremely useful. Probably many of the water powers now being surveyed will not be made use of for a considerable time, but everyone acquainted with the development of hydraulic power knows how unreliable records of stream flow may be if taken over short periods, so that the longer the period of observation is, the more accurate will be the calculations based on the records obtained.

On the recommendation of the Commission referred to above, an area of 17,900 sq. miles has been assured protection against denudation by the setting aside of the eastern slope of the Rocky Mountains as a forest reserve. This is a very wise measure, as it will tend to regulate the flow of the rivers and prevent floods and droughts. Similar steps are recommended regarding the drainage area of the Winnipeg River. In this vast country, although in the past much harm has been done by cutting down forests, so far as stream regulation is concerned, a great deal of good can be accomplished by the prevention of further damage in the future.

The Dominion Government has recently decided to reserve all vacant Dominion lands which may be valuable for the development of water power, in order to keep them from the hands of speculators, so that only promoters of *bona fide* power development may secure them.

A few months ago a Research Committee, consisting of prominent scientists and engineers, was organised by the Dominion Government, and these men are taking up many questions of national importance in connection with the development of Canada's resources in water powers, minerals, timber, &c.

One subject which is receiving particular attention is the utilisation of lignite in the Prairie Provinces. In Saskatchewan there are immense deposits of this material, and the Department of Mines is carrying out experiments on briquetting and burning it, with a view to its being made use of commercially on a big scale.

The development of water powers for the fixation of atmospheric nitrogen, and generally for great electrochemical industries, is also receiving attention.

The chairman of the Timiskaming and Northern Ontario Railway has recently been advocating the electrification of the whole line of some 328 miles. As this line runs through a good deal of thickly wooded country, and as steam railways in Canada annually cause a vast amount of damage to forests by fire, some people take the view that it would pay the country to have such a line electrified, merely for the saving in forest fire destruction, which might thereby be prevented.

The coal situation has been very acute this winter, and prices for bituminous coal, which is mostly used for power purposes, have been about three times as much as in pre-war days, while anthracite, which is extensively used for heating houses, &c., has been 30 per cent. or 40 per cent. higher than before the war; besides this, the railway freight facilitiies have been so completely tied up, due to one cause or another, that it has been sometimes impossible to obtain coal at any price. Toronto University had to close all its buildings for several days quite recently, as no coal was to be had, and the temperatures were zero F., or below, about that time. Preference has in all cases been given to the munitions plants, and even some of these have had a hard time to keep going, for want of coal.

TRADE STATISTICS OF CANADA.

The following figures, showing the imports into and exports from Canada of electrical and similar materials during the year ended March 31st, 1916, are taken from the recently-issued trade statistics. Figures for the year 1914-15 are given for purposes of comparison, and notes of any increases or decreases have been added:—

IMPORTS.

	1914-15. Dols.	1915-16. Dols.	Inc. or dec. Dols.
Copper wire, plain, tinned, or plated.—			
From United Kingdom ...	2,000	—	– 2,000
,, United States ...	23,000	18,000	– 5,000
Total	25,000	18,000	– 7,000
Electric light carbons and carbon points.—			
From United Kingdom ...	1,000	—	– 1,000
,, United States ...	36,000	50,000	+ 14,000
,, Germany	6,000	—	– 6,000
,, Other countries ...	1,000	2,000*	+ 1,000
Total	44,000	52,000	+ 8,000
*Switzerland $2,000.			
Incandescent lamp bulbs, &c.—			
From United Kingdom ...	1,000	—	– 1,000
,, Austria	8,000	—	– 8,000
,, Germany	4,000	—	– 4,000
,, United States ...	54,000	62,000	+ 8,000
,, Other countries ...	3,000	1,000	– 2,000
Total	70,000	63,000	– 7,000
Electric apparatus not mentioned (insulators, batteries, telegraph and telephone instruments).—			
From United Kingdom ...	538,000	207,000	– 331,000
,, Austria	2,000	—	– 2,000
,, France	9,000	2,000	– 7,000
,, Germany	68,000	—	– 68,000
,, Sweden	41,000	3,000	– 38,000
,, Switzerland ...	2,000	—	– 2,000
,, Italy	8,000	3,000	– 5,000
,, United States ...	3,675,000	3,367,000	– 308,000
,, Other countries ...	1,000	—	– 1,000
Total	4,344,000	3,582,000	– 762,000
Manufactures of india-rubber and gutta-percha (except tires, clothing, and similar goods).—			
From United Kingdom ...	224,000	193,000	– 31,000
,, Austria	3,000	—	– 3,000
,, France	3,000	2,000	– 1,000
,, Germany	24,000	—	– 24,000
,, United States ...	621,000	625,000	+ 4,000
,, Other countries ...	2,000	2,000	—
Total	877,000	822,000	– 55,000
Gasoline engines.—			
From United Kingdom ...	85,000	32,000	– 53,000
,, United States ...	1,905,000	3,376,000	+ 1,471,000
,, Other countries ...	44,000	1,000	– 43,000
Total	2,034,000	3,409,000	+ 1,375,000
Steam engines.—			
From United Kingdom ...	67,000	12,000	– 55,000
,, United States ...	170,000	95,000	– 75,000
Total	237,000	107,000	– 130,000
Steam boilers.—			
From United Kingdom ...	35,000	33,000	– 2,000
,, United States ...	163,000	81,000	– 82,000
Total	198,000	114,000	– 84,000
Concrete mixing, cement-making, and coal-handling machines.—			
From United Kingdom ...	7,000	1,000	– 6,000
,, United States ...	241,000	91,000	– 150,000
,, Other countries ...	1,000	—	– 1,000
Total	249,000	92,000	– 157,000
Electric motors, generators, and dynamos.—			
From United Kingdom ...	175,000	35,000	– 140,000
,, France	2,000	—	– 2,000
,, Sweden	25,000	2,000	– 23,000
,, United States ...	1,146,000	863,000	– 283,000
,, Other countries ...	1,000	1,000	—
Total	1,349,000	901,000	– 448,000
All machinery not mentioned, except sewing machines, textile machinery, printing machinery, &c.—			
From United Kingdom ...	992,000	302,000	– 690,000
,, France	5,000	2,000	– 3,000
,, Germany	110,000	—	– 110,000
,, United States ...	8,091,000	12,140,000	+ 4,049,000
,, Other countries ...	66,000	53,000	– 13,000
Total	9,264,000	12,497,000	+ 3,233,000
Iron and steel wire, single or several, covered with cotton, linen, silk, rubber, or other material, including cables so covered.—			
From United Kingdom ...	159,000	5,000	– 154,000
,, United States ...	175,000	160,000	– 15,000
,, Other countries ...	4,000	1,000*	– 3,000
Total	338,000	166,000	– 172,000
* France.			
Lighting fixtures of metal (including electric).—			
From United Kingdom ...	11,000	10,000	– 1,000
,, Austria	1,000	—	– 1,000
,, United States ...	401,000	310,000	– 91,000
,, Other countries ...	5,000*	10,000†	+ 5,000
Total	418,000	330,000	– 88,000
*Germany $6,000. †Japan $5,000.			

EXPORTS.

	1914-15. Dols.	1915-16. Dols.	Inc. or dec. Dols.
Mica.—			
To United Kingdom ...	32,000	34,000	+ 2,000
,, United States	184,000	195,000	+ 11,000
,, Other countries ...	2,000	—	– 2,000
Total	218,000	229,000	+ 11,000
Electrical apparatus.—			
To United Kingdom ...	17,000	142,000	+ 125,000
,, Newfoundland ...	16,000	17,000	+ 1,000
,, United States	49,000	52,000	+ 3,000
,, Other countries ...	16,000	362,000*	+ 346,000
Total	98,000	573,000	+ 475,000
*Spain $340,000.			
Machinery (other than linotype, washing, and sewing machines).—			
To United Kingdom ...	40,000	252,000	+ 212,000
,, Newfoundland ...	20,000	23,000	+ 3,000
,, New Zealand	5,000	2,000	– 3,000
,, Argentina	21,000	2,000	– 19,000
,, France	9,000	12,000	+ 3,000
,, United States	188,000	371,000	+ 183,000
,, Russia	11,000	34,000	+ 23,000
,, Other countries ...	20,000*	44,000	+ 24,000
Total	314,000	740,000	+ 426,000
*Australia $9,000.			
Gasoline engines.—			
To United Kingdom ...	7,000	10,000	+ 3,000
,, Newfoundland ...	94,000	63,000	– 31,000
,, United States	13,000	11,000	– 2,000
,, Other countries ...	3,000	2,000	– 1,000
Total	117,000	86,000	– 31,000

BUSINESS NOTES.

Bankruptcy Proceedings.—Fred. W. Chamier, electrical, &c., engineer, 59 Fleet Street, E.C.—An application for an order of discharge, was made to Mr. Registrar Hope at the London Bankruptcy Court on March 21st, on behalf of bankrupt, who failed in October, 1913, with ranking liabilities £511, and assets valued at £18,517, made up of book debts stated to be due from companies and persons in Russia and Germany. The Senior Official Receiver (Mr. E. Leadam Hough) reported that for six years prior to 1911, the bankrupt acted as manager at Frankfort-on-Main for an electrical apparatus manufacturing company, in which he had acquired a controlling interest, but which had, prior to the receiving order, gone into liquidation. In 1912 he came to England and began his career as a consulting engineer. With regard to the assets disclosed by the bankrupt, the chief item was a claim for £76,700 (estimated to produce £15,000) against the Deutsche Beck Bogenlampen Gesellschaft M.b.H., of Frankfort-on-Main. As offences, the Senior Official Receiver reported: (1) insufficiency of assets to equal 10s. in the £ on the amount of the liabilities, nothing having been realised from the before-mentioned claim and book debts; and (2) omission to keep proper books of account. After hearing Mr. J. D. Kingham, in support of the application, his Honour granted a discharge subject to judgment for £300, to be satisfied by a cash payment of £50 within one month, and the balance within a further twelve months. Order entered accordingly.

S. S. Coster & Co., electrical and mechanical engineers, 14, Gladstone Road, West Ham Park, Essex.—Receiving order made March 29th on a creditor's petition. First meeting, April 3rd; public examination, May 9th, both at Carey Street, W.C.

E. W. Barton Wright, electrical therapeutic expert, Acton (formerly 133, Oxford Street, W.).—Order made March 23rd, at Brentford, discharging receiving order. Composition, 5s. in the £. April 11th is the last date for sending proofs for dividend to E. W. J. Savill, Official Receiver, 14, Bedford Row, W.C.

Book Notices.—*Our Weights and Measures.* By Allan Granger. London: Eyre & Spottiswoode, Ltd. Price 6d.—In this booklet the author takes the view that to change our system of weights and measures would involve a serious disturbance of trade customs and social habits, and a large expenditure, and that the consequences of a partial change would not be so grievous. He sees no probability of the adoption of the metric system, and lays emphasis on the enduring value of measures of length, in contrast to the mutability of measures of weight and volume; and therefore, whilst he proceeds to put forward simplified and improved measures of weight and capacity, he refrains from suggesting any change in measures of extension. Proposing a new pound equal to the half-kilogram, Mr. Granger bases upon it a new cwt. (50 kg.) and a new ton (1,000 kg.), and subdivides it into 16 new ounces and 7,680 new grains. He also increases the gallon by 10 per cent., making it practically equal to 5 litres, with a new pint, &c. We will not follow the author through his arguments in favour of these changes; his proposals appear to be directed towards retaining the old names whilst practically adopting the values of the metric units of weight and capacity, and obviously the disturbance to trade which he foresees in the event of the metric units being adopted would not be avoided—except in respect of length measurements—were his suggestions carried out. To our mind, half-measures are not only useless, but mischievous; if we are to change at all, let us place ourselves *completely* in harmony with other nations by adopting the metric system outright.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVI, No. 3. March, 1917. New York: The Institute. Price $1.

"The Calculation and Measurement of Inductance and Capacity." By W. H. Nottage. London: The Wireless Press, Ltd. Price 2s. 6d. net.

"Electrical Laboratory Course for Junior Students." By M. Maclean. London: Blackie & Son, Ltd. Price 2s. net.

"The Engineer's Year-Book for 1917." By H. R. Kempe. London: Crosby Lockwood & Co. Price 20s. net.

Patent Application.—Notice of application by the British and Overseas Engineering Syndicate, Ltd., for leave to amend Patent No. 15,599 of 1913, granted to V. Poulsen for "Improvements relating to the production of alternating electric currents," appears in our advertisement pages to-day.

Dissolutions and Liquidations.—Ashworth & Parker, Riverside Works, Bury, Lancs.—Mr. W. A. Ashworth has retired from the firm. The business will be continued under the same name by the remaining partners, Messrs. W. S. Parker & F. O. L. Chorlton.

London Electron Works, Ltd.—The controller, Mr. A. Taylor, has applied for his release.

Simplex Insulators (Bourke's Patent), Ltd.—Meeting of creditors, April 5th, at 56, Moorgate Street, E.C.

Meirowsky & Co., Old Trafford, Manchester, enemy subjects.—Creditors in this case must send particulars to the Controller, Mr. G. H. Warmington, 33, St. Swithin's Lane, E.C., by April 23rd.

Aluminium Stamping Co., Ltd., Garnham Street, Stoke Newington, N.—First meetings of creditors and contributories, April 4th, at Carey Street.

Colston Electrical Works, Ltd., Bristol.—April 11th is the last date for the receipt of proofs for dividend, by Mr. C. H. King, the liquidator, at 26, Baldwin Street, Bristol.

Catalogues and Lists.—British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—Twenty-eight-page illustrated price list, No. 10,600 A, giving full particulars of an extensive range of "Calorite" electric heating appliances.

British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park.—Special publication, No. 7,855/1, of 36-pp., contains a reprinted illustrated article from the *Beama Journal* on "The Control of Motors for Industrial Purposes," by Frank Walker.

Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Mailing card No. 653 describes, illustrates, and gives prices of their combination pin-plug and lampholder adaptor.

The "Z" Electric Lamp Manufacturing Co., Ltd., of Southfields, S.W., have prepared some large adhesive labels for the use of the trade generally. They are supplied free of charge, overprinted with the trader's name and address.

For Sale.—The controller, Mr. H. J. Morland (Price, Waterhouse & Co.) is inviting tenders, by April 18th, for the purchase, as a going concern, of the business of The Brimsdown Lamp Works, Brimsdown. Full particulars are given in our advertising pages to-day.

American Westinghouse Extensions.—Announcement has just been made by the Westinghouse Electric and Manufacturing Co. that the plot of ground recently purchased at Essington, near Philadelphia, will form a new industrial centre for the Westinghouse Electric interests. The site embraces about 500 acres, with a frontage of approximately one mile on the Delaware River. Additional transportation facilities will be afforded by tracks from the Pennsylvania and Philadelphia and Reading Railroads. This new centre will be devoted to the production of large apparatus, the first group of buildings being for power machinery, principally steam turbines, condensers and reduction gears. The initial development will cost in the neighbourhood of $5,000,000 or $6,000,000, occupying about one-fifth of the area of the entire plot. The group will consist of the following buildings:—Two large machine shops, an erecting shop for heavy machinery, forge shop, pattern and pattern-storage shop, and power house. Work will begin on these as soon as satisfactory building contracts can be let. The number of employés to be engaged at the new plant will number several thousand people, and, undoubtedly, will in the future equal the number employed at East Pittsburgh, representing over 20,000 people.—*Journal of Electricity, Power and Gas.*

Trade Announcements.—Mr. L. Vandervelde has purchased the business of D. Jaroslaw, together with the assets, and he will conduct the business under his own name at 19, Tower Hill, London, E.C., and will discharge liabilities. Mr. Vandervelde has been manager of the firm for more than 20 years.

Mr. T. J. Farrell, electrician, of 5, Moss Lane, Altrincham, is giving up the business.

The address of Mr. Syd. H. Symmons has been altered to 9, Mincing Lane, London, E.C., 3. Telephone No.: "Avenue 6893."

The "Z" Electric Lamp Manufacturing Co., Ltd., have opened a branch at 59, Victoria Street, Bristol (manager, Mr. W. Weeks, late of Messrs. Veritys, Bristol). Stocks of all classes of their lamps, as well as accessories and cables, will be carried.

LIGHTING AND POWER NOTES.

Aylesbury.—Plant Extension.—Mr. Turnbull, electrical engineer to the U.D.C., has interviewed the authorities with respect to the likelihood of increasing the plant at the works in order to supply current to a local controlled establishment in the town. As a result, the Council has asked the L.G.B. if it will be prepared to grant sanction to a loan for the purpose.

Begelly (Pembrokeshire).—Electrical pumping and winding plant is being installed at the New Reynalton Colliery; electrically-driven screens and washers are also to be erected.—*Western Mail.*

Bootle.—The Corporation electricity works have made a surplus of over £3,000 for the past year, and the reserve and renewal fund accounts show a credit balance of £19,765. The reserve fund has nearly reached its maximum limit.

Clayton.—A public meeting, last week, held to consider the question whether the township should seek electric supply from the Yorkshire Electric Power Co. or from the Bradford Corporation, passed a resolution instructing the Council to rescind its recent decision to support the company's Bill at present before Parliament, including Clayton in its area of supply, and to send a copy of the resolution by telegram to the B. of T. The comparative charges are as follows:—The company: Lighting, for any quantity, 5d. per unit; heating and cooking, any quantity, 1d. per unit; power, from 9d. to 1d. per unit, all subject to a discount of 2½ per cent. Bradford: Flat rate of 4d. per unit; maximum demand rate from 1½d. to 7d. per unit; heating, cooking, and small power installations, 1d. to 2d. per unit net; large power installations, ½d. to 2d. per unit; discount, 2½ to 3 per cent.

Dundee.—On Tuesday morning, last week, a fault occurred in an E.H.T. trunk feeder supplying a sub-station, with the result that a portion of the tramway supply and that of some works was temporarily stopped. On the following morning the second feeder to the same sub-station failed, causing an interruption in E.H.T. supply. On localising the fault, the ground, which is chiefly composed of gas works refuse, was found to be on fire under the cables, which accounted for their giving way. The cables were laid some five or six years ago in fibre conduit surrounded by concrete, and at that time the ground gave no indication of such an occurrence being possible.

Dublin.—Docks Supply.—As a result of an inquiry into the cost of working of the Dublin Port and Docks Board electricity station, it has been found that the units generated during 1916 were 437,840; the generating cost was 2·5d. per unit; interest, sinking fund, 1·119d. per unit; salaries, ·110d. per unit, making a total of 3·76d. per unit. The average cost per unit sold by the Dublin Corporation for 1916 was 2·62d., which included all charges. It is suggested that it might be possible to enter into an arrangement by which the Corporation would take over the Port and Docks Board station and supply the Board with electricity at a lower price than it is costing at present.

Grimsby.—The T.C. has entered into an agreement with the Great Central Railway Co. for a supply of electricity for emergency purposes.

Hornsey.—According to the estimate of the Electricity Supply Committee, there will be a deficit of about £700 on the year's working. Councillor Moritz said that in increasing the charges by 25 per cent. in two steps the anticipations of increased revenue had been fulfilled, and he thought that they would be in a position to carry on until the end of the war without putting any further burden upon the consumers. The undertaking had only had the benefit of the 25 per cent. increase for one quarter, and when they had had longer experience of it he hoped the finances would show the advantage.

London.—Hackney.—The Electricity Committee reported that the official tests of the 5,000-kw. turbo-alternator and auxiliary plant installed by Messrs. Willans & Robinson, Ltd., had been carried out to the satisfaction of the borough electrical engineer.

The Committee recommends that, subject to the approval of the L.G.B., an annual subscription of £5 5s. be paid to the Engineering Standards Committee.

Lambeth.—The Council has agreed with the Deptford B.C. that representations be made to the Commissioner of Police urging that street lighting, except at dangerous corners, be dispensed with during the months of May, June, and July.

Mexboro'.—Proposed Loan.—The U.D.C. has decided to ask the Treasury for permission to raise £9,500 for an additional electricity works extension, subject to the sanction of the L.G.B.

Morecambe.—Proposed Extension.—The T.C., last week, considered a proposition by the Electricity Committee that application be made for sanction to borrow £6,000 for electricity works extensions, at the expiration of the war. The Committee reported that a generating set was required to meet the demands of the department. Councillor West questioned whether £6,000 would be enough. Alderman Birkett asked whether the whole existing plant might not be better scrapped. He pointed out that the works had never been a paying concern, and said that was largely due to the unfavourable situation. Despite the fact of Parliament having asked the Council to state what money was likely to be required after the war, the Council ultimately referred the matter to Committee.

Northwich.—Price Increase.—The Northwich Electric Supply Co. has given notice that certain of the charges at present made for current for lighting purposes will, on and after July 1st, 1917, be revised as follows:—Sliding scale: Now 6½d. and 4½d., in future 7d. and 4½d. Flat rate:—Now 5½d., in future 6d. per unit.

Perth.—An estimate of the cost of the electrical stoking plant erected four years ago was submitted, at a meeting of the Gas Committee, by Mr. David Vass, gas manager. A total of £6,200 was spent on the installation, and since the introduction of that plant £3,347 has been paid in respect of retort-house extensions.

Rochdale.—New Plant.—Mr. W. J. H. Wood, borough electrical engineer, Bolton, the consulting engineer to the Corporation, has reported on the condition of the electricity works, and the Electricity Committee recommends the T.C. to spend a sum of about £20,000 to put the undertaking in the necessary condition of efficiency to meet the growing demands. In May last year an expenditure of £60,000 was proposed, but it was vetoed, and an outlay of only £10,000 was sanctioned. It is stated that the application will have official support. Mr. Wood reports a marked improvement in the general running of the plant, and says there is no doubt the staff have been fighting against adverse circumstances and abnormal conditions in the past. His proposals accepted by the Committee provide for one 750-kw. rotary converter, £3,000; additional water intake and screens, £1,000; and two boilers, with stokers, and coaling plant, flues and buildings, £15,000. An item of £4,500, put down as the estimated cost of linking up with a neighbouring authority for a stand-by supply, has been postponed for further inquiries.

The bursting of a tube in a boiler, last week, put one of the boilers out of action, and considerably reduced the supply of current.

Shildon (Durham).—The Council considered, last week, a letter from the Electric Supply Co., agreeing to accept £150 in full settlement of its lighting account, and stating that it might be necessary to again raise the rate for current. It was decided to settle the claim, and to ascertain the right of the company to increase its charges.

South Africa.—The Cape Town Corporation Electric Light Department has given notice that, consequent upon the delay in securing the additional generating and boiler plant due to the war conditions, no extensions to existing installations can be permitted, or new connections for purposes other than domestic lighting be made, until the installation of the additional plant.

Stockton-on-Tees.—It is expected that there will be a fairly considerable loss on the working of the Corporation's electricity undertaking during the present financial year, although not as much as the £2,000 allowed for in the estimates.

Wakefield.—Year's Working.—There has been a loss of £1,300 on the working of the electricity undertaking for the past year, due to increased cost of labour, coal, and oil.

West Ham.—The borough engineer estimates a deficiency on the electricity undertaking of £35,500 for the year ending March 31st, 1917, together with a further sum of £4,500 for allowances to men on Active Service—total, £40,000. On the tramways for the same period the deficiency is estimated at £15,500, and a further sum of £16,100, allowances to men on Active Service—total, £31,600. The Finance Committee is to be asked to provide for the foregoing deficiencies in the estimates. Upon the recommendation of the electrical engineer the revised standard charges for lighting, power and heating, operating from the March, 1917, meter reading period, are to be advanced by 10 per cent., such advance to come into force in connection with all existing standard supplies, as and from the date of the meter reading immediately following the expiration of six months' notice.

Willesden.—The Electricity Committee has decided to terminate the agreement with the North Metropolitan E.P.S. Co. on March 31st, 1918, and that negotiations be entered into with the company with a view to a new agreement. The L.G.B. has refused to sanction the raising of a loan of £10,110 for new cables.

TRAMWAY and RAILWAY NOTES.

Bingley.—Linking-up.—Deputations from the Bingley U.D.C and the Keighley R.D.C. met the Keighley Corporation Tramways Committee last week, to exchange views on the linking-up of the Bradford tramway service which runs through Bingley to Cross Flatts, and the Keighley tramways which run to the bottom of Stockbridge, a matter of 2¼ miles. All three parties are favourable to the proposal, and the next step is to ascertain the views of the Bradford Corporation, who lease the line through Bingley. The scheme is held to be highly desirable as a means of through traffic between Bradford and Keighley, and particularly so in view of the high railway fares.

Birmingham.—The use of the Boy Scouts in assisting the women conductors on the Corporation tramcars has proved very successful, and the Tramways Committee proposes to avail itself of the services of the boys on all routes. The boys give the signal to stop and restart the cars, and generally attend to the platform duties, while the conductress collects the fares.—*Birmingham Daily Despatch.*

Blackpool.—Revenue Returns.—At March 16th, with only 16 days more to run of the present financial year, the total Corporation tramway receipts were £90,603, compared with £77,429 last year, an increase of £13,173. In 1913, the record for the department, the full year's receipts were £84,000, and this year's full takings will be over £92,000, thus beating the record by over £8,000.

The Watch Committee has decided to licence women drivers on the Corporation cars, thus reversing the decision of last year. A number of women drivers are now in training in preparation for the coming season.

Bootle.—There is a deficit of £2,822 on the Corporation tramways account for the past year, an increase of £1,811 above the estimated deficit. A sum of £4,689 in respect of rental payable by the Liverpool Corporation has not yet been paid. An increased expenditure of £4,000 is estimated this year, with an estimated loss of £6,080, of which £2,262 is for reserve. Extensive track repairs and renewals largely account for the increased expenditure.

Burnley.—Accident.—About 10.30 p.m. on March 23rd, two tramcars came into collision near Duke Bar; none of the passengers were hurt, and the damage was very slight.

Huddersfield.—The Tramways Committee has transferred £8,800, equal to a 4d. rate, to the borough fund in relief of next year's borough rate. In regard to the service of cars to Marsden, a suggestion by the tramway manager is to be carried out as an experiment. This is for the use of special cars, with an

arrangement of fare-paying before entering the cars which will ensure preferential entry for long-distance passengers, for whom the cars are chiefly provided. Ordinary fares are to operate when the car moves into service.

Newcastle-on-Tyne.—Rate Relief.—At a meeting of the City Council, last week, for fixing the rates, Councillor Mayne, chairman of the Tramways Committee, offered £7,000 from his Committee's funds. The profits at the end of the year are estimated at £36,000. To bring the reserve fund up to the requisite figure of £100,000, would require £29,000. That left £7,000 at the disposal of the Council. Several members spoke against acceptance of the money, claiming instead a cheaper and more efficient service; other members were not satisfied that the money might not be required for renewals, repairs, and the like. Acceptance was agreed to by 36 votes to 8.

Preston.—An application of the permanent-way men to to be granted a war bonus has been referred to the Workmen's Wages Sub-Committee; it is recommended that the Council join with other Lancashire and Cheshire tramway authorities to consider combined action to secure greater uniformity in fixing areas and conditions of labour.

Salford.—The increased fares on the Corporation tramways come into operation on Monday. War bonuses and allowances paid to dependents of employés serving with the Forces have caused an additional annual expense of not less than £30,000, and it is hoped by the Committee that the fare and stage revision will be sufficient to meet the increased financial obligations, and also make a substantial contribution towards the relief of the rates. One of the changes is the abolition of the halfpenny fare for children, and all children occupying seats must be paid for.

Stalybridge.—The Joint Tramways Board has received complaints of the crowded state of the cars on certain routes in the early morning, and the manager has been instructed to write to the owners and managers of mills suggesting a variation in the times of commencing and ceasing work, so as to minimise the pressure at certain hours.

York.—When the City Council met last week to consider the estimates, Ald. Rhodes Brown said that instead of the estimated profits there was a loss of £700 on the tramways and £1,470 on the electricity undertaking. Ald. Meyer, chairman of the Tramways Committee, said the higher prices, including labour, represented 50 per cent. of the expenditure, while the 6s. war bonus represented 25 per cent. of the increase; also there was a decrease in efficiency. Unless transport undertakings could charge more for their services, they could not be run at a profit. The Electricity Committee had given notice of an increase of 10 per cent. in its charges, but they could not increase the tramway fares, as these were fixed by Act of Parliament.

TELEGRAPH and TELEPHONE NOTES.

Bagdad Wireless Station.—A powerful wireless installation at Bagdad, constructed by the Germans, and in direct communication with Berlin, was blown up by the enemy before the arrival of the British Forces on March 11th.

Electrophones in Hospitals.—The free electrophone service given by the Electrophone Co. to many London hospitals and homes for wounded soldiers and sailors includes an installation at the London Hospital, by which 100 patients can listen whilst lying in bed to the performances at the leading musical comedy theatres and music halls.—*Daily Telegraph.*

Imperial Communications.—The Royal Commission on the Natural Resources, Trade, and Legislation of the Empire, in its report, issued this week, includes a statement that cheaper cable rates are an urgent necessity, and that public opinion in all the Dominions is in favour of State control of the Imperial lines. The acquisition of an Atlantic cable by the State is recommended, and a considerable reduction in Press rates is proposed for the cheap and wide dissemination of Imperial news.

Post Office Telegraphs and Telephones.—The annual report of the Postmaster-General for 1915-16 was issued last week. It states that 68,000 Post Office servants are with the Colours, and 7,000 more will be set free when required. Nearly 2,000 have lost their lives, and many honours have been won by Post Office employés. The depletion of the trained staff has thrown a heavy strain on the Department, which has had to carry out new work on an extensive scale, and to deal with phenomenal development in certain branches, while it has constructed and maintains a network of telegraph and telephone lines for the use of the Home Defence Forces, and its factories are engaged on munition work and in making telegraph and telephone apparatus for use in the field.

Increased charges were brought into force in October and November, 1915, and brought in (up to March 31st, 1916) about one million sterling additional revenue; the extra charges included:—On telegrams, 3d. per message, realising £200,000; on telephones, flat-rate (unlimited) lines, £3 per line in London, £1 10s. and £2 in the Provinces; trunk calls, an increase of one-third (but a large reduction in trunk traffic occurred, and the yield was only £80,000, whereas £120,000 was expected); and call office charges were increased by 1d., realising £10,000, as against £60,000 estimated.

On March 31st, 1916, the total mileage of wires was 3,264,822 miles, an increase of 6·3 per cent.; telegraph wires amounted to 264,480 miles, telephone wires to 2,843,254 miles, and spares to 157,088 miles; aerial wires, 1,022,036 miles; underground wires, 2,229,055 miles; and submarine wires, 13,731 miles.

The storm in March, 1916, was the worst in the history of the telegraph and telephone services, especially in the Midlands, where every line crossing a belt of country in a northern and southern direction was brought down: 2,150 poles were broken, 6,050 uprooted, and 33,300 blown over. This involved the re-erection of 41,500 poles, equivalent to 14,000 miles of main pole line, and about 1,500 tons, or 17,000 miles, of copper wire had to be replaced. Owing to shortness of staff, the work of repair occupied many months.

A large number of special telegraph circuits was provided for Government departments, and Government traffic nearly doubled. The number of telegraph offices open on March 31st, 1916, was 14,156, a decrease of 66. The number of telegrams handled was 84,157,000, of which 64,685,000 were ordinary (a reduction of 7¼ millions), 3,695,000 Press (a reduction of ¾ million), 7,503,000 foreign (a reduction of nearly 2 millions), and 7,128,000 Government (an increase of 3,410,000). The revenue from paid traffic was £3,111,235, an increase of £97,326; unpaid traffic was estimated at £538,461, an increase of £270,182.

The decrease in ordinary inland traffic was 10·4 per cent., and in Press telegrams 17 per cent. To compensate for the withdrawal of telegraphists for military service, additional operators have been trained, telephone transmission has been employed, and the use of high-speed apparatus has been extended. The Committee appointed in 1914 to consider the various systems of high-speed telegraphy reported in January, 1916. The use of the telephone for the dispatch and delivery of subscribers' telegrams has been fostered, and the telephone has been substituted for the sounder at a large number of small offices.

Foreign telegrams showed a substantial decrease in number, but an increase in length, with the result that the revenue was slightly higher. The use of nine codes has been authorised. An "urgent" telegraph service with Russia and Roumania was introduced in January, 1916, at triple rates.

The development of the telephone system has been seriously retarded by want of funds and labour. New orders for 43,286 telephones were accepted during the year, and over 5,000 circuits were provided for Government departments. It was impossible to keep pace with the applications for new telephones, and a war surcharge (minimum £4) was imposed to limit the demand, with the result that the applications were reduced by 50 per cent., and a sum of £45,000 was brought in during the seven months ending March 31st, 1916. Notices to remove 54,680 telephones were received, an increase of 4 per cent. Apart from 15,000 telephones provided for the temporary use of Government departments, the Post Office owned on March 31st, 1916, 786,991 telephones, of which 263,135 were in London, 406,347 in England and Wales, 91,221 in Scotland, and 26,282 in Ireland; 776 million effective calls were originated, a decrease of 4·8 per cent. The total number of inland trunk calls was 40,357,284, a decrease of 0·56 per cent. New exchanges opened numbered 71, making the total number 3,109; 751 public call offices were opened, and 991 closed. Seventy-four exchanges were connected with the trunk system, and 126 additional trunk circuits were completed; the amalgamation of trunk and local exchanges was also carried further. The London-Birmingham cable was extended to Liverpool, and a new cable between London and Brighton was brought into use. Short-distance trunk services have been accelerated. Automatic exchanges are in satisfactory operation at the General Post Office (London), Accrington, Chepstow, Darlington, Epsom, Hereford, Newport (Mon.), and Portsmouth. The war has delayed the construction of similar exchanges at Leeds, Grimsby, and Stockport. Continuous telephone service is now provided at all except 334 exchanges. Rural party lines increased by 133 to 2,398. It is estimated that 7,721,000 telegrams, 115,900 express letters, and 5,650 ordinary letters were sent by telephone. The receipts from private telephone lines were £248,078, as compared with £263,108. In London, the new Charterhouse exchange is approaching completion, but work on the Bishopsgate Tower, and Holborn exchanges has been suspended. During the year the telegraph factory at Birmingham was completed. The total expenditure out of telephone capital on sites and buildings was £94,894.

The expenditure on the telegraph service amounted to £5,155,850, and the revenue to £4,786,391, leaving a net deficiency (adjusted) of £502,670, of which £278,616 was allotted to depreciation, and £271,691 to interest on the purchase of the telegraph system. The plant was valued at £7,692,420, less depreciation £2,429,373. The expenditure on the telephone service was £7,463,809, and the revenue £7,362,315, leaving a net deficit (adjusted) of £128,013; the plant was valued at £27,768,535.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.— U.D.C. Electricity Department. Battery of accumulators, complete. See "Official Notices" March 16th.

Aylesbury.— Electricity Department. 200-kw. direct-coupled internal-combustion engine and generator, fuel plant, and accessories. See "Official Notices" to-day.

Bray.—April 3rd. U.D.C. Stores for electric light works. See "Official Notices" March 23rd.

Bury.—Overhauling and maintenance of private telephone system for Bury District Co-operative Society, Ltd. Particulars at Office, Knowsley Street.

Glasgow.—April 5th. Corporation. Turbo-alternators (15,000 KW.), transformers, and condensing plant for the new generating station at Dalmarnock. Particulars from Mr. W. W. Lackie, Chief Engineer and Manager, 75, Waterloo Street, Glasgow.

Hull.—April 12th. Electricity Committee. Cooling towers. See "Official Notices" March 23rd.

London.—ST. PANCRAS.—April 12th. B.C. Arc lamp carbons. See "Official Notices" March 9th.

Manchester.—April 3rd. Corporation Electricity Department. Stuart Street generating station. Low-pressure water pipes, &c. Mr. F. E. Hughes, Secretary.

Warrington.—April 11th. Electricity and Tramways Committee. One 3,000-KW. turbo-alternator and surface condensing plant. See "Official Notices" March 16th.

April 11th. Electricity and Tramways Committee. Motors and transformers. See "Official Notices" March 23rd.

CLOSED.

Glasgow.—The T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for three 1,000-KW. rotary converters, at £3,160.

Leyton.—Trolley wire: British Insulated and Helsby Cables, Ltd.

FORTHCOMING EVENTS.

Association of Mining Electrical Engineers (Lancashire, Cheshire and North Staffs. Branch).—Joint meeting with the Colliery Managers' Association. Saturday, March 31st. At 3 p.m. At the Technical College, Stoke. Paper on "The Electrification of a Group of Collieries," by Mr. H. Green.

(West of Scotland Branch).—Saturday, April 7th. At 4.30 p.m. At the Royal Technical College, Glasgow. Annual meeting.

Institution of Civil Engineers of Ireland.—Monday, April 2nd. At 8 p.m. At 35, Dawson Street, Dublin. Ordinary meeting.

Society of Engineers.—Monday, April 2nd. At 5.30 p.m. At Burlington House, Piccadilly, W. Paper on "Ball Bearings," by Mr. A. M. Arter.

Institution of Electrical Engineers (Western Local Section).—Monday, April 2nd. At 5 p.m. At the Merchant Venturers' Technical College, Bristol. Annual meeting.

(Scottish Local Section).—Tuesday, April 3rd. At 7.30 p.m. At 207, Bath Street, Glasgow. Paper on "Some Points in connection with Engineering Specifications," by Mr. J. Shepherd. Annual meeting.

(Manchester Local Section).—Tuesday, April 3rd. At 7 p.m. At the Engineers' Club. Lecture by Prof. E. Wilson. Annual meeting.

Institution of Civil Engineers.—Tuesday, April 3rd. At 5.30 p.m. At Great George Street, S.W. Discussion on the paper on "The New Electric Power House at Birchills, Walsall."

Roentgen Society.—Tuesday, April 3rd. At 8.15 p.m. At the Cancer Hospital, Fulham Road. Discussion on "The Future of the British X-Ray Industry," to be opened by Mr. G. Pearce. Sir Jas. Mackenzie Davidson, Prof. Porter, F.R.S., Major Wilson, and others have consented to take part in the discussion.

Liverpool Engineering Society.—Wednesday, April 4th. At 7.30 p.m. At the Royal Institution, Colquitt Street. Paper on "The Michell Thrust Block and Journal Bearing," by Mr. J. H. Gibson.

NOTES.

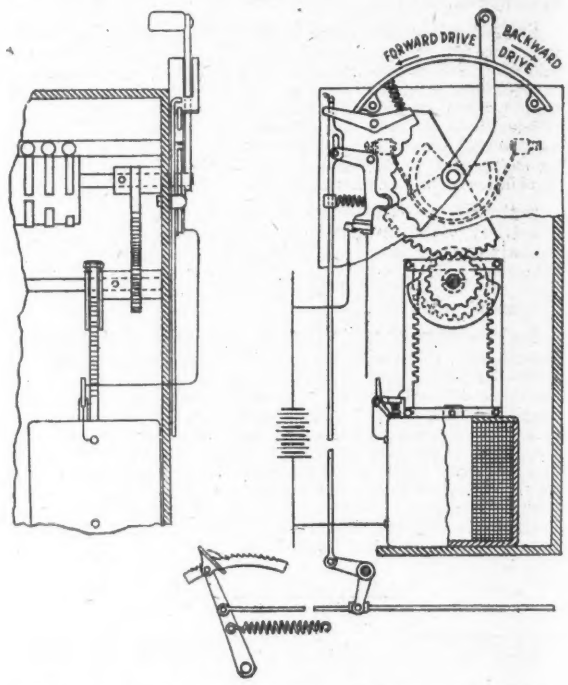
Easter Holidays.—The next issue of the ELECTRICAL REVIEW will be published on Wednesday morning, April 4th, instead of April 6th (Good Friday). All matter should be in our hands at the earliest possible moment, as announced last week.

A Safety Controlling Device for Electric Motor Vehicles.—With the object of eliminating the waste of current of the battery of an electric motor vehicle, and the danger of injury to the electric motor, if the controller is not returned to the neutral position when the brakes are applied, an ingenious device has recently been patented by an American electrical engineer, Mr. S. S. Amdursky, of Rochester, N.Y., by means of which such neutralising of the controller is automatically effected whenever the brakes are applied. This is accomplished by the electro-magnetic mechanism depicted in the accompanying diagrams, fig. 1 being a front elevation of the controller and the added mechanism, and fig. 2 a side elevation.

The electro-magnetic mechanism consists of a solenoid magnet mounted in the base of the controller case. Two vertical racks, connected at top and bottom by horizontal cross-pieces, are attached to the top of the movable core of the magnet. A mutilated gear, carried on a small horizontal countershaft below the top of the rack framework, when it is in its highest position, meshes with the teeth of the racks. Another pinion mounted on the same shaft as the mutilated gear meshes with a segmental gear pivoted to the controller shaft, as indicated in fig. 2.

In the drawings, the controller handle is shown in its neutral position. When it is moved either backwards or forwards to give a forward or reverse speed, the segmental gear on its shaft revolves the pinion on the countershaft, causing the teeth of the mutilated gear to engage one of the racks, and raise the rack framework and the core out of the solenoid. If the latter is energised after the parts have been moved in this manner, it tends to pull the core and the rack framework down again, thus racking the several gears back to their normal position, and causing the controller to return to neutral.

In order that the energising current for the solenoid shall only be employed when the brake is applied, it is controlled through an electrical circuit, which is opened and closed by the brake manipulation. In fig. 2 the solenoid is shown connected with the leads of an electric battery—which may be the battery that supplies the current for driving the vehicle; the free ends of the wires of the circuit are attached to two contact pieces which can make contact with the lower end of a bell-crank lever shown near the top left corner of fig. 2. The other end of the bell-crank has a pin which works in a slot in the top of a vertical rod, the latter in turn being connected with the brake rod by another bell-crank. As the brake rod moves by pressure on the brake pedal, the vertical rod is pushed up, turning the bell-crank and its contact point so that



FIGS. 1 AND 2.—SAFETY CONTROLLING DEVICE FOR BATTERY VEHICLE.

the later closes the solenoid circuit, consequently automatically bringing the controller back to a neutral position. The releasing of the brake allows the vertical rod to move down and break the circuit, so that the controller can be moved again in either a forward speed or reverse direction.

The extreme top of the vertical rod also serves to prevent the controller from being moved from the neutral position while the brake is applied. The upper end of the rod is bent in the shape of a hook, which engages with one arm of a detent pivoted to the controller casing; the other arm engages with a bevelled lug mounted on the controller shaft. So long as the brake is not in use, the detent is held on the bevelled lug by a small coil spring. When the brake is applied, the upward movement of the hook at the end of the vertical rod permits the detent to be released, and when the controller returns to its neutral position, the detent rides over the bevelled lug and snaps in position behind it, as shown in fig. 2. The detent is so arranged, however, that it does not prevent movement of the controller to the reverse position, since there may be occasions when it would be desirable to move the controller to such a position while the brake is applied, in order that the electric motor may be used to supplement the action of the brakes in reducing the speed of the vehicle or in bringing it to a standstill.

Provincial Electric Supply Committee.—We are pleased to learn that the Committee formed to represent the provincial electric supply authorities of England holding Provisional Orders has already met with a full measure of success. The appeal met with the complete concurrence of the companies interested, and in a short space of time some 60 provincial companies, representing between 200 and 300 Provisional Orders, have become members. The bulk of the capital invested in provincial companies is therefore represented, amounting to some seven or eight million pounds, and all the important companies in the United Kingdom are included. In view of the many serious problems with which the electric supply industry may have to deal in the immediate future, the Committee should form an excellent means of focusing the active lines of policy of the various companies on any such questions.

Volunteer Notes.—First London Engineer Volunteers.—Headquarters: Balderton Street, Oxford Street, W.

Special Notice.—The Commandant congratulates the Corps on having received official recognition. He trusts that *every member* will make it convenient to attend at headquarters on Monday, April 2nd, between 6 and 7, for medical examination and attestation.

Monday, April 2nd.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8. Medical examination, 6.

Wednesday, April 4th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 1.

Thursday, April 5th, to Monday, April 9th.—Headquarters closed during Easter. Training at Esher. Special orders will be sent to each Volunteer who has sent in his name.—(By order), Macleod Yearsley, *Captain and Adjutant.*

Board of Trade Departmental Committee on Electricity Supply.—As foreshadowed in our last issue, the President of the Board of Trade has appointed a Committee to consider and report what steps should be taken, whether by legislation or otherwise, to ensure that there shall be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, particularly industries which depend upon a cheap supply of power for their development. The Committee is constituted as follows:—The Right Hon. F. Huth-Jackson (chairman), Mr. H. Booth, Mr. James Devonshire, Mr. J. Falconer, M.P., Mr. G. H. Hume, Mr. John Kemp, Mr. H. H. Law, Mr. C. H. Merz, Sir Charles Parsons, K.C.B., Sir John Snell, Alderman C. F. Spencer, and Mr. A. J. Walter, K.C. The secretary of the Committee is Mr. M. J. Collins, to whom all communications on the work of the Committee should be addressed at the Board of Trade, 7, Whitehall Gardens, London, S.W.1.

Dublin Electricity Undertaking.—The death of Mr. Elward, Chief Inspector of Consumers' Supplies under the Dublin Corporation's electricity department, has led to a proposal that his successor might discharge dual duties, and so effect a considerable saving without interfering with the efficiency of the undertaking. Other re-arrangements are stated to be in contemplation.

Strike of Electricians at Athens.—Dispatches from Reuter's agent at Athens state that, as the result of a strike of electricians belonging to the Pan-Hellenic Union, the supply of electric current was stopped in Athens and the Piræus, "and presumably in other towns," with a consequent cessation of communications, lighting, and industry. An agreement with the Government was subsequently arrived at, an assurance being given that the men's claims would be considered.

Inquiries.—Makers of a battery automatic cut-in and cut-out switch, *without mercury contacts*, are asked for; also makers of electrical apparatus for relieving deafness. A correspondent seeks information on the manufacture of permanent magnets and the composition of the steels employed.

The Metric System.—On Tuesday evening, at a meeting of the Institution of Civil Engineers, Mr. Harry Allcock delivered a lecture on the Metric System, before a large audience. Mr. Allcock dealt first with decimal coinage, advocating the adoption of the florin as the base, divided into 100 parts; he showed that for many years the business community had pressed for this reform, and that the change would not involve any serious disturbance to trade. He then stated the case for the adoption of metric weights and measures, pointing out that the system was already largely used in Russia, and that if we led the way, the United States would be sure to follow our example. Manufacturers need not fear any interference with their internal organisation, as the Bill to be introduced into Parliament would make the use of the system obligatory only in commercial transactions, and any alterations in designs, tools, &c., would be entirely optional.

A lengthy discussion followed, in which Sir Guilford Molesworth, Mr. Oliver Berry, Sir Archibald Denny, Mr. J. A. F. Aspinall, Mr. E. C. Barton, Prof. Lupton, Dr. Hunter, and others took part. A report will appear in our next issue.

The sense of the meeting was unmistakably favourable to the reforms advocated by Mr. Allcock, the opposition being of a trivial description.

No B.A. Meeting.—It is announced that the meeting of the British Association arranged for Bournemouth this year will not be held, owing to the restriction of railway travelling and other circumstances.

Re Meirowsky & Co.—Messrs. George Schultz & Co., Ltd., of 10, Arthur Street, London, E.C., wish it to be understood that the winding-up of the affairs of Meirowsky & Co., A.-G., in this country, by the Board of Trade, as publicly announced, does not in any way affect the position or business of their company, in which only British subjects have been and are interested.

Electrochemistry in France.—The *Journal du Four Electrique et de Electrolyse* remarks on the part played by French electrochemical works during the war. Acetylene is employed as an illuminant in sapping and mining operations, for motor-car lights, and more especially in autogenous soldering. Calcium cyanamide helps in the production of nitrate of ammonia, the base of several explosives. Ferro-chrome, ferro-silicon, ferro-tungsten, and ferro-molybdenum are utilised in the making of steels. Aluminium is employed in steel works, the making of fuses, aeroplanes, automobiles, and in certain explosives such as ammonal, which is a mixture of nitrate of ammonia and powdered aluminium. The manufacture of chlorine gas has had a sudden development; the same is true of the manufacture of various other products such as sodium, magnesium, the ferro-cyanides, electric steels, ferro-manganese, and nitric acid. These manufactures have borrowed next to nothing from abroad; the electrical energy was supplied by French hydro-electric works, and the greater part of the raw materials was procured from the soil of France or from that of her colonies.

Institution and Lecture Notes.—Royal Institution.—The list of lecture arrangements after Easter has been issued. It includes the following:—

May 11th, 5.30 o'clock.—Prof. J. Jolly, F.R.S., "Radioactive Haloes."
" 18th, " Prof. F. Soddy, F.R.S., "The Complexity of the Chemical Elements."
June 8th, " Prof. Sir J. J. Thomson, P.R.S., "Industrial Applications of Electrons."
April 19th and 26th, at 3 o'clock.—Prof. H. S. Foxwell on "Industrial Finance After the War." (1) The Industrial Struggle of To-day; (2) Its Financial Needs: How They Can Best be Met.
May 5th, 12th, 19th, 26th } at 3 o'clock.—Prof. Sir J. J. Thomson, P.R.S.,
June 2nd and 9th } on "The Electrical Properties of Gases."

Electrical Association of Australia.—At the third annual meeting of the Victorian Section, the report of the Council stated that a Sub-Committee dealing with the licensing of wiremen had drafted suggestions, and was arranging for a conference with the Contractors' Association and the Wiremen's Union. The Council expressed the hope that a final scheme would be agreed to, enabling the proposals to be placed before Parliament. The proposed incorporation of the Association and the question of the use of letters after members' names had been referred to the Federal Council for its consideration. The total number of members of all classes was 227. The balance-sheet showed receipts £324, and the credit balance was £176.

The following officers were elected for the year:—President, Wilfred N. Kernot; past presidents, W. H. Alabaster, F. A. McCarty; vice-presidents, A. McKinstry, A. N. Macnicol; hon. sec., A. Maling; hon. treasurer, G. B. Lincolne; members of Council, F. W. Clements, H. R. Harper, A. L. Hargrave, A. W. Kendall, J. C. Lane, W. J. Newbigin, H. Clement Newton; hon. auditors, A. C. E. Pulling, C. C. Gray.—*Commonwealth Engineer.*

Appointments Vacant.—Electrical staff, for the aerodromes and hutted camps in the Southern Command. For particulars see our advertisement pages to-day.

Restrictions on the Importation of Certain Goods.—A Supplement to the *Board of Trade Journal* of March 29th contains a complete list of articles the importation of which into the United Kingdom has been prohibited, except under licence, by Royal Proclamations of February 15th, 1916, and subsequent dates, and in respect of which applications for licences should be addressed to the Controller, Department of Import Restrictions, 22, Carlisle Place, Westminster, London, S.W. 1.

I.E.E. Wiring Rules.—In view of the great demand by the Government for small stranded wires, the Council has decided to permit for the period of the war the use of single-strand conductors up to No. 14 S.W.G. (see Rule 42).

NEW COMPANIES REGISTERED.

Isenthal & Co., Ltd. (146,791).—Private company. Registered March 22nd. Capital, £5,000 in £1 shares. To take over the business of an electrical engineer and manufacturer of and dealer in electrical and mechanical apparatus carried on by A. W. Isenthal, at Denzil Works, Willesden, N.W., as Isenthal & Co. The subscribers (each with one share) are: A. W. Isenthal, 95, The Avenue, Ealing, W., electrical engineer; Mrs. C. R. Isenthal, 95, The Avenue, Ealing, W.; L. F. Fogarty, Dene Cottage, Ruislip, Middlesex, electrical engineer. The first directors are A. W. Isenthal (permanent), C. R. Isenthal, and L. F. Fogarty.

The Double Arc Electric Welders, Ltd. (9,782).—Private company. Registered in Edinburgh on March 16th, with a capital of £1,000 in 980 ord. shares of £1 each and 800 def. shares of 6d. each. Objects: As indicated by the title. The first directors are M. M. Irvine and R. Irvine. Solicitor: J. L. Mackie, Glasgow.

Nottingham Electro-Plating Co., Ltd. (146,641).—Private company. Registered March 19th, with a capital of £7,000 in £1 shares (3,000 pref.), to take over the business carried on by E. Wilford at 98, Sherwood Street North, 85a, Mansfield Road, and 32, Upper Parliament Street, Nottingham, as the Nottingham Electro-Plating Co. The subscribers (each with one share) are: E. Wilford, 98, Sherwood Street North, Nottingham, electroplater; Miss N. Wilford, 10, Mapperley Road, Nottingham. First sole director: E. Wilford. Solicitors: Warren & Allen, Nottingham.

Hackbridge Cable Co., Ltd. (146,684).—Private company. Registered March 20th, with a capital of £25,000 in £1 shares, to take over the business of cable makers, electrical engineers, &c., carried on at Hackbridge, Surrey, as the Hackbridge Manufacturing Co. The subscribers (each with one share) are: H. Allwood, Dignall, Stanley Park Road, Wallington, Surrey, engineering works manager; A. Kent, Clovelly, Marshalls Road, Sutton, Surrey, cable engineer and manager. Permanent governing director: C. W. Bloomfield. Registered office: London Road, Hackbridge, Surrey.

Burdette & Co., Ltd. (146,713).—Private company. Registered March 21st, with a capital of £6,000 in £1 shares (1,000 pref.), to take over the business of electrical and general engineers carried on by P. Speedy, G. L. Eynon, and J. Meech, at 7, Pocock Street, S.E., as Burdette & Co. The subscribers (each with one ord. share) are: Mrs. G. L. Meech, 29, Pearfield Road, Forest Hill, S.E.; J. Meech, 29, Pearfield Road, Forest Hill, S.E., electrical engineer; P. Speedy, 6, Duke Street, Adelphi, W.C., electrical engineer; G. L. Eynon, 6, Duke Street, Adelphi, W.C., engineer. The first directors are: J. Meech, P. Speedy, and G. L. Eynon.

Mayall & Co., Ltd. (146,594).—Private company. Registered March 17th, with a capital of £1,500 in £1 shares, to take over as from February 28th the business of factors of and dealers in electrical and mechanical equipment, &c., carried on by J. W. Mayall at 147, Corporation Street, Birmingham, as Mayall & Co. The subscribers (each with one share) are: J. W. Mayall, 147, Corporation Street, Birmingham, electrical engineer; E. A. Couzens, The Uplands, West Heath, Northfield, mechanical engineer. The first directors are: J. W. Mayall (permanent director and chairman) and E. A. Couzens. Registered office: 147, Corporation Street, Birmingham.

Hudson's Electrical Engineering Co., Ltd. (146,731).—Private company. Registered March 21st, with a capital of £1,000 in £1 shares, to take over the business of an electrical engineer carried on at 3, Prudential Buildings, Park Row, Leeds, and elsewhere, as Hudson & Co. The subscribers (each with one share) are: J. A. Atkinson, 17, Clarendon Place, College Road, Leeds, solicitor; G. Harper, Ashlea, Thorpe, near Wakefield, contractor. The first directors are to be appointed by the subscribers. Solicitor: A. Willey, Calverley Chambers, Victoria Square, Leeds.

Nicholson & Crockett, Ltd. (146,743).—Private company. Registered March 21st, with a capital of £500 in £1 shares, to take over the business of manufacturers of and dealers in electrical and scientific instruments carried on by J. N. Clark and L. C. A. Aylett, as Nicholson & Crockett, at 116, Dallow Road, Luton. The subscribers (each with one share) are; J. N. Clark, 6, Vernon Road, Luton, scientific instrument maker; L. C. A. Aylett, 116, Dallow Road, Luton, scientific instrument maker; J. P. G. Aylett, 10, Roseberry Road, Chelmsford, works accountant. The first directors are: J. N. Clark (chairman), L. C. A. Aylett, and J. P. G. Aylett. Registered office: 116, Dallow Road, Luton.

Power Engineering Co., Ltd. (146,808).—Private company. Registered March 22nd, with a capital of £1,000 in £1 shares, to take over the business of engineers, welding experts, manufacturers of wood and rubber blocks, cranes, hoists, tubes, &c., carried on at Manchester by E. R. Voigt & Partners as the Power Engineering Co. The subscribers (each with one share) are: Emil R. Voigt, 69, Hodge Lane, Prestwich, Manchester, engineer; Ernest M. Ginders, 75, Albert Avenue, Prestwich, Manchester, engineer. The first directors are: Emil R. Voigt (permanent director and secretary), Ernest M. Ginders, and Mrs. M. Voigt. Registered office: Thomas Street, Cheetham Hill, Manchester.

J. & W. B. Smith, Ltd. (146,734).—Private company. This company was registered on March 21st, with a capital of £70,000 in £1 shares, to acquire from the executors of the late J. G. Watkinson the business of manufacturers of and dealers in gas, electrical, glass, sanitary, and ironmongery goods, &c., formerly carried on by the said J. G. Watkinson, in succession to J. & W. B. Smith. The subscribers (each with one share) are: F. Watkinson, 196, Camden Road, N.W., works manager; A. H. Miller, 29, Ailsa Road, Westcliff-on-Sea, accountant; J. Macmin, 15, Dowgate Hill, E.C., solicitor. The executors of the late J. G. Watkinson may, while holding £500 shares, appoint a governing or ordinary director. Helene Watkinson (one of such executors) may, while they and she hold £1,000 shares; appoint a governing director by will or codicil. Secretary: E. A. Irwin. Registered office: 19, Farringdon Road, E.C.

Eclipse Carborundum & Electrite Co., Ltd. (146,853).—Private company. Registered March 24th, with a capital of £10,000 in £1 shares, to take over the business carried on at Apollo Works, South Road, New Southgate, N., as the United Carborundum & Electrite Works, Ltd., and the Vincit Co., Ltd. Agreements (*a*) with T. E. Fowler, and (*b*) between the above companies, C. Eves, and T. E. Fowler, for the purchase of assets by the said T. E. Fowler. The subscribers (each with one share) are: T. E. Fowler, 10, Beaconsfield Road, New Southgate, N., manufacturer; P. H. Goodwin, 85, St. Kilda Road, West Ealing, W., clerk. The first directors are: J. F. Beale, S. R. Beale, and T. E. Fowler. Directors must be British, and the usual provisions for ensuring the general British nature of the company are inserted in the Memorandum of Association. Solicitors: Kenneth Brown & Co., Lennox House, Norfolk Street, W.C.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Shipley District Council has advanced the salary of Mr. W. REDMAN, its electrical engineer, from £250 to £300 per annum.

The Aylesbury U.D.C. has increased the salary of Mr. TURNBULL, its electrical engineer, to £225 per annum, rising to a maximum of £250 by £12 10s. a year.

The Hackney B.C. Establishment and General Purposes Committee recommends the following special grants to the undermentioned officers of the electricity department for additional work performed by them in consequence of the war:—Mr. J. R. J. Bowden, deputy electrical engineer, £50; Mr. T. Dalby, works and sub-station superintendent, £30; Mr. P. M. Shears, canvasser, £20; Mr. E. Wilkinson, generating engineer, £10; Mr. A. G. Helling, assistant distributing engineer, £10; Mr. J. F. Heathman, chief clerk, £10. The Committee recommends that the designation of Mr. P. M. Shears be sales engineer.

The Bexhill-on-Sea T.C. has appointed Mr. R. C. CARTER, who has been on the staff for two years, as assistant electrical engineer.

General.—Coun. RICHARD HOLT, J.P., the Deputy-Mayor, is the new chairman of the Blackpool Tramways and Electricity Committee. He was vice-chairman to the late Ald. James Brodie.

Mr. B. J. GRIGSBY, A.M.I.E.E., who has been identified with the Benjamin Electric, Ltd., London, since 1908, and was managing director until December last, when he resigned in order to return to the States and take up interests acquired there, has been elected a director, and is now vice-president and general manager, of the Anderson Electric Speciality Co., 562-564, West Van Buren Street, Chicago, U.S.A.

Acting-Corporal N. K. THOMSON, from the R.H. and R.F.A., has been granted a commission in the Tyne Electrical Engineers, R.E. Second-Lieutenant Thomson was gazetted on March 7th.

Roll of Honour.—A member of the staff of the Hendon Electric Supply Co., Ltd., P.O. J. F. SLADE (R.N.A.S. Armoured Cars, Russian Squadron), has been awarded the St. George's Medal. Writing to Mr. Drummond, the company's manager, he says: "We have had some exciting times in Roumania, and as a result of the work of the car crews several of our fellows have received decorations."

P.O. ALLAN WATSON, of the same company, is now attached to the same branch of the service, which is doing excellent work in Russia.

Private HARRY HEPWORTH, A.S.C., one of the oldest employés in the Blackpool Corporation tramways department, has succumbed to pneumonia in a military hospital at Liverpool. He was about 41 years of age.

Lance-Corporal E. NETTLETON, West Yorkshire Regiment, killed in action, was employed as electrician by Mr. Harry Moss, electrical engineer and contractor, Bradford.

Obituary.—MR. J. S. RAWORTH.—We record with deep feelings of regret the death of Mr. John Smith Raworth, M.Inst.C.E., M.I.E.E., which occurred on March 24th at Streatham Hill, London, at the age of 71 years. Mr. Raworth was so well known and so popular a member of the electrical fraternity that his death will evoke from many quarters expressions of sorrow at the loss which the profession and industry have sustained. We were privileged to count him as one of our oldest electrical friends, and desire to express on our own behalf, as well as on behalf of our readers who knew him and appreciated his many excellent qualities, our deep sympathy with his widow and children. The late Mr. Raworth had been associated with the electric lighting and traction industries from their inception, indeed, it is close upon 40 years since he put up the first installation of electric lighting in Manchester. He served his time in the shops and drawing offices of Messrs. R. & W. Hawthorn, of Newcastle-upon-Tyne, and of Messrs. Wren & Hopkinson, of Manchester, and he approached the designing of electrical machinery from the point of view of the mechanical engineer rather than from that of the electrician. He represented Messrs. Siemens Bros. in Lancashire in the late seventies and early eighties of last century, devoting his attention largely to ship lighting, first with arc and then with incandescent lamps. It was practically a case in which bricks had to be made without straw, for though there were dynamos, lamps, and wires available, such things as high-speed engines, fittings, switches, and switchboards, castings, &c., were non-existent, and types and patterns of his own had to be evolved which have persisted, forming the basis for several distinct trades. His early work in connection with ship installations on such ships as the *City of Berlin, City of Rome, Arizona, Alaska, Orient*, &c., left its influence on ship lighting plant for many years. While at Manchester, however, he was engaged with many other matters as well. For instance, he ran, for a time, a small central station distributing current in its immediate neighbourhood, and most of the important Manchester installations erected in those days were done under his superintendence. He put up the first electrically-worked hoist. In 1886 he came to London, and settled here, taking a leading position with the Brush Electrical Engineering Co., then operating under another title. The company was in a state of transition, and difficulties were numerous, but the world was beginning to awaken to electrical possibilities, and a good deal of useful work was done by him as responsible head of the engineering department. When the Electric Lighting Act of 1888 was passed he was entrusted with many enterprises, including the supply stations of the City of London Electric Lighting Co., the Leicester Corporation, and others at Huddersfield, Hanley, Bournemouth, and elsewhere. Many of these were wholly, or in great part, designed by him. When he joined the Brush Co. a 50-H.P. dynamo was about the limit of their capacity, but when he left ten years later—in 1896—a 1,000-H.P. combined plant, including both engine and generator, was an ordinary order for them. The works at Loughborough were designed, erected, and equipped under his superintendence, and that being completed, he exchanged the position of chief engineer for a seat on the board, and commenced practice in Westminster as a consultant. He was already technical adviser to several important electrical undertakings, among which was the British Electric Traction Co. Although lighting and power schemes claimed much of his attention, his interest became more and more diverted towards tramways, until he eventually undertook the technical directorship of the B.E.T. Co. He was actively associated with this company for many years. Mr. Raworth has been a prolific inventor, yet one seldom hears his name associated with any particular machine; even the high-speed engine that he invented was always known as the "Universal." His regenerative patents, however, were put forward under his name. Mr. Raworth was a man of strong personality. Subtlety of mind, ready wit, and oratorical powers of a high order, were among his characteristics, and he could always be reckoned upon to add life and interest to an Institution discussion in the years when he could be more frequent at meetings at Westminster than had latterly been the case. He had been in failing health for two or three years, and his presence had been sadly missed.

MR. W. H. HALLIWELL.—The *African World* records the death of Mr. W. H. Halliwell, acting general manager to the Lobito, Benguella, and Catumbella Electric Light & Power Co., Ltd., who died of fever in hospital at Lobito on 17th inst. Mr. Halliwell only returned from England to Lobito a few months ago to take over the general managership, pending the absence of the general manager, Mr. E. H. Rhodes, on leave. He formerly acted as Mr. Rhodes's chief assistant at Benguella.

MR. ARTHUR BROOKER.—We regret to learn that Mr. Arthur Brooker, general manager of the Automatic Telephone Manufacturing Co., Ltd., of Liverpool, and known to electrical students everywhere as joint author of the widely-used "Slingo and Brooker" electrical compendium, passed away on March 23rd at his residence, Ashfield, Huyton. We hope to refer to the deceased gentleman's career in our next issue.

We extend our sincere sympathy to Mr. C. P. ELIESON on the death of his wife, which occurred on March 27th at 24, St. Mary Abbotts Terrace, Kensington, S.W.

CITY NOTES.

Newcastle-upon-Tyne Electric Supply Co., Ltd.

The annual meeting was held on March 23rd. Mr. J. H. Armstrong, who presided, referred to the satisfactory results of the year's work (see Elec. Rev., March 16th). The engine-house at Carville, when completed, would accommodate five large turbines. 270 of their employés had gone to the Front, and six had lost their lives. The vacancies on the staff had been partly filled by female labour and partly by discharged service men. As it was necessary that some of these men should have certain technical knowledge, they had established regular classes for them, at which lectures were delivered and demonstrations given by their own officials, and this systematic training had proved most beneficial, and the men and women were giving every satisfaction. The directors had been in negotiation with the Cleveland & Durham Electric Power, Ltd., with the object of this company acquiring an interest in the latter concern, and the directors had decided to remommend that this company should make an offer to acquire, by exchange of shares, the shares and funded preference income stock of the Cleveland Co., and he now submitted the scheme for their approval. The Cleveland Co. had 300 miles of cables laid in its area; it had 81,469 H.P. connected; and its gross profit for 1916 was £37,129. The Teesside area had excellent facilities both by rail and by sea, and had during recent years shown the promise of becoming a very large industrial centre. Quite recently it had given indications of more active development; in fact, there was every reason to believe that before many years the Tees district would hold a leading position in the industrial enterprise of the North-East Coast. The Cleveland Co. in its early days suffered through not having behind it a nucleus of profit to go on with, such as the Newcastle Co. had in its lighting load, and the result was that the Cleveland Co. had nothing to assist it while its money was being expended on capital account from which no adequate return was immediately received. The Cleveland Co. benefited very much from the fact that the majority of the waste-heat stations were in its immediate area; in fact, it obtained the bulk of its power from the waste-heat stations, and it was only when the war broke out and the effect of the war on collieries was such that their output was reduced, that there was a considerable falling off temporarily in waste heat from these stations. The result was that the Cleveland Co. had to fall back on the coal-fired generating station at Grangetown, from which it had to get a very considerable portion of its supply, and that had a very adverse effect on the profits of the past two years for the station named, partly owing to its situation, and partly owing to the class of plant installed, which was far from an economical one. The Cleveland Co. had received many applications for additional current from its present customers, as well as applications from new manufacturing undertakings, but from the difficulties with which it was faced they did not see their way to take advantage of the position. This position became acute before the end of last year; hence the negotiations. The chairman indicated the advantages that would accrue to the Newcastle Co. from the acquisition of the Durham Co., and said that certain developments could be carried out much more cheaply by them than by the Durham Co., adding that if the stations were run conjointly considerable economies would be possible. The directors of the Newcastle Co., realising the many advantages that would so accrue, and also the advantage it would be to the interests of power supply, which had become a matter of great national importance, urged that advantage should be taken of the opportunity now offered of closer union with the Cleveland Co., and strongly recommended the approval of the scheme. They reserved the right to withdraw the offer in the event of their not receiving a satisfactory response from the Cleveland shareholders. He formally moved that the proposals for acquiring the shares of the Cleveland and Durham Electric Power, Ltd., be approved. The report was adopted without opposition.

Cleveland and Durham Electric Power, Ltd.

Mr. James Falconer, M.P., presided at the annual meeting, held on March 23rd. He said that the gross profit showed an increase of £5,972. It was proposed to pay a dividend of 2 per cent. on the preference shares. There had been some inquiries as to why they were not paying more than that amount, but it was all that they could safely and prudently give. With reference to the proposed arrangement with the Newcastle Electric Supply Co., as the result of a conference between the Cleveland board and that of the Newcastle Co. terms were adjusted, subject to the approval of the Newcastle Co., which approval had been given that day. In due course an offer would be made, accordingly, to each shareholder in the Cleveland Co. for his shares on the terms adjusted subject to the condition that if there was not an adequate response to the offer the Newcastle Co. was at liberty to withdraw it. The directors unanimously recommended the acceptance of the offer. With regard to the progress and position of the company, the best method of showing it was to look at the revenue and costs of the company and of its associated companies for a period of years. He gave the figures for the last four years. In 1913 the revenue was £131,933, in 1914 £141,482, in 1915 £151,512, and in 1916 it was £192,434. The costs were: 1913, £91,640; 1914, £95,914; 1915, £110,368; and 1916, £141,312. These figures showed that a large and progressive business had been established, the revenue having increased by £60,501. It was not possible to arrive at an actual comparison between the results of the war period and those of the pre-war period, as the conditions were different in many material respects, but, making every allowance, it was evident that the development had been substantial and well maintained. The increase in the cost in the period named was from £91,000 to £141,000, an increase of £49,672. It would thus be seen that the increased cost had absorbed about four-fifths of the revenue in the last four years. By far the greater part of that increase was due to the increased cost of generating current by coal-fired stations in consequence of the war. This was shown by the following figures: The cost was in 1913, £845; in 1914, £5,338; in 1915, £16,400; and in 1916, £37,753. That increased cost seriously affected the company, and the company, notwithstanding the development of its business, had been unable since the war began to pay the full dividend on the preference shares. The amount paid on those shares had been from 5 per cent. down to 2 per cent. In these conditions of increased volume of business and increased cost, they found themselves met with a demand for additional supply from existing consumers and urgent requests to meet proposed developments in the district. The iron and steel industries had been called to make large extensions of the plant, and all the indications were that there would be other large extensions, as well as the establishment of new works in the area. Thus there would be a large demand for current, much larger than in the past. They had made some steps to meet that additional supply, but the directors had been met with the necessity of extending the plant at a time when the raising of additional capital was a matter of exceptional difficulty. The directors had found it impossible to arrange during the war either for the construction of additional waste-heat plant or to obtain the capital necessary for an adequate extension of coal-fired generating plant. It was under those circumstances the conference he had mentioned took place with the board of the Newcastle Co., and the arrangements set out in the circular they had received were framed. With regard to the terms proposed, he might at once say they were not based on the present market price, because the shares were not quoted, nor yet were they based on the war results, but they endeavoured to arrive at terms fair to both parties having regard to the value of the area and the future prospects of business. Their only regret was that while they had advanced so far they had not secured the full measure of success for the shareholders which, under ordinary circumstances, they would have obtained. The report was adopted. It was intimated that the shareholders would have until April 14th to consider the Newcastle Co.'s offer, and if a sufficient number of shareholders accepted, the matter would be carried through.

Minehead Electric Supply Co., Ltd.

Lighting restrictions reduced the sale of energy for lighting purposes. Fuel and all materials increased in cost, and the repairs were unusually heavy owing to the fracturing of the crankshaft of the six-cylinder high-speed vertical suction gas engine. Units sold for heating and cooking show an increase. Total units sold 236,533, against 230,416 for 1915. Units generated 341,158, used on works 24,532, not accounted for 80,093. Average price obtained fell from 3.40d. to 3.36d. per unit. Profit, after paying debenture interest, £1,466, plus £142 brought forward. After paying the preference dividend and 8 per cent., less income-tax, on the ordinary shares, paying bonuses to certain officials £60, and putting £850 to depreciation and reserve, £56 is to be carried forward.

Brompton and Kensington Electricity Supply Co., Ltd.

The credit balance for 1916 is £23,938, plus £6,012 brought forward, and £177 interest. Seven per cent. is paid on the preference shares, £5,104 is put to depreciation, £2,000 to reserve, 9 per cent. is paid on the ordinary shares, directors' additional remuneration takes £501, and there is to be carried forward £5,075. The number of consumers increased from 6,512 to 6,678, and the 8-C.P. lamps connected by 18,452, making 345,744. The gross receipts decreased from £56,469 to £55,878; expenditure increased from £30,074 to £31,940; net receipts fell from £26,395 to £23,938; the average price obtained per unit increased from 4d. to 4.1d.

Automatic Telephone Manufacturing Co., Ltd.

Mr. J. Taylor presided at the annual meeting, on Monday, at Liverpool. He said that during 1916 the factory had been working day and night. They had, however, been able to complete the automatic installations at Portsmouth, Paisley, and Blackburn, and all the exchanges erected to date were giving satisfaction, which was a good augury for the future. They had every reason to believe that the Leeds exchange—the largest automatic exchange to be erected in this country—would be finished for service as soon as the Post Office was ready for it. Owing to shortage of staff and other calls, this department had not been able to proceed with its part of the scheme as rapidly as expected. The cash balance, £139,877,

was a large increase on 1915, but Excess Profits Duty had to be met out of it. The balance was due to increased trading and a quicker turnover. The works were fully employed, and were likely to continue so until the end of the war. When the end came they were bound to suffer, inasmuch as it would be quite impossible to cease the manufactures on which they were now engaged and revert to their ordinary business without considerable loss of time and money. They were doing their best to anticipate the situation. It was mentioned later that Mr. E. A. Mellinger, a director, was at present in America keeping alive in various parts of the world the trade that under war conditions they could not possibly do in this country.

British Insulated & Helsby Cables, Ltd.

Dr. E. K. Muspratt presided at the annual meeting, held at Liverpool on Monday. He said that the good results shown in the report were the outcome of a much larger volume of business in money value during the year than ever before. The changes made to enable them to manufacture articles comparatively new to them, and the curtailment of their ordinary trade, and the stoppage of almost the whole of the export business, all pointed to the fact that after the war new and strenuous efforts would have to be made to enable them to resume the important position that they formerly held. Doubtless some of the new departments would help to attain that end. The difficulty of retaining sufficient skilled men had been very great, and the employment of women workers had been greatly increased wherever it had been possible. The amount of the capital expenditure was reduced from £651,175 to £645,522, as they had provided by depreciation £5,653 more than was expended upon capital account; this it was considered wise to do, having in view that after the war some rearrangement of the plant and machinery would be necessary. The employment of so much unskilled female labour had unduly increased the wear and tear of the plant, and had necessitated the provision of a larger sum for depreciation. The conditions under which business had been conducted during the year had been very onerous. The committees set up for the control of raw material, the provision of men, the adjustment of taxation, the welfare of workpeople, &c., were very numerous, and the difficulty in satisfying the desires of conflicting bodies, such as those who wanted the company's men and those who were desperately in need of the product of their labour, had made the position very difficult, and, in addition to having had to carry on with a reduced staff, there was now required by these numerous committees an unprecedented number of returns, and forms to be filled in with minute particulars, involving a very great deal of labour. In ordinary times it would have been possible to create a new department for the conduct of this additional business, but the work had to be done by a staff which had lost many of its well trained workers, and he told the shareholders this that they might understand that the thanks he offered on their behalf to the staff and workpeople were sincere. He would like specially to name the general manager, Mr. Dane Sinclair, Mr. Nisbett, Mr. Brotherton, and the secretary, Mr. Kerfoot, upon whom so much of this additional strain had fallen.

The adoption of the report was seconded by Sir Harmood Banner, M.P., who referred to the necessity for them all to consider well, and to use their best efforts to arrange proper terms for, trade after the war. Their company was well equipped and quite ready to meet any competitors, but they were bound to see that conditions of trade after the war were somewhat better than before in the protection of British interests, and to see that Great Britain got her fair proportion of the work to be done in the world. They must not let anyone intervene. All the labour they had prepared and which after the war would be available for commercial work ought to be protected in such a way that they would have in the future as much success as in the past.

Folkestone Electricity Supply Co., Ltd.

The profits for 1916 are very satisfactory. 4,480 lamps (8-c.p.) added bring up the total equivalent to 157,931. Owing to high price of fuel and freightage difficulties, charges to consumers have had to be raised. The company holds £15,000 War Loan. Including receipts from hired installations, the profit on the revenue accounts of the three undertakings is £16,373, plus £2,602 brought forward. After paying debenture interest and preference dividend, and Excess Profits Duty for two years ended December, 1915, £5,000 is put to depreciation fund and £1,000 to reserve, and 7 per cent. dividend is paid on the ordinary shares, carrying forward £2,594. Units generated, 2,310,837; units sold, 1,618,000.

W. T. Henley's Telegraph Works Co., Ltd.

The profit for 1916 was £198,270, less £87,154 for directors' and auditors' fees, debenture interest, income-tax, and amount written off for depreciation on buildings and machinery, plus £55,264 brought forward, making £166,380. There is transferred to reserve in respect of depreciation of trustee securities £7,650, to reserve account £20,000, to special war allowance reserve account £5,000, preference dividend £9,000; 15 per cent. dividend on the ordinary shares, plus a bonus of 10s. per share, both less income-tax, £50,000, to staff pension and benefit fund £5,000, carrying forward £69,730. A reserve has been made in the accounts in respect of liabilities for special taxation under the Munitions of War and Finance Acts. As the greater part of the factory machinery has been running day and night on special work, a considerable sum has again been provided for depreciation on this account, and provision has been made also for machinery which has been bought specially for war purposes, and which will be useless after the war. The number of women employed exceeds 800. The company's holding in the new War Loan is £200,000, of which £105,000 is new money. Of the staff and workmen 796 have joined the Forces, and there have been 133 casualties, including 30 deaths. Six have been awarded honours. Annual meeting: To-day (Friday).

Madras Electric Tramways (1904), Ltd.

The gross profit for 1916 is £24,408. After debiting interest and London office expenses, providing for debenture stock sinking fund, putting £6,000 to depreciation and renewal account, the balance is £13,124, plus £4,273 brought forward. Six per cent. is paid on the preference shares, and 8 per cent. on the ordinary; £2,500 is put to general reserve; £4,315 is carried forward subject to Excess Profits Duty (if any). The traffic receipts increased by 8.3 per cent. The cost per mile run rose 6.1 per cent., due chiefly to increased prices of materials and higher rates of freight The undertaking has been maintained out of revenue, and special improvements and renewals have been debited to the depreciation and renewal account.

South London Electric Supply Corporation, Ltd.

At the annual meeting, on 20th inst., the Chairman said that the results for 1916 were satisfactory, the total receipts having increased by £4,255, or 7.8 per cent., and £28,388 had been carried to net revenue, against £27,229 in 1915. Coal had cost £3,226 more, and rates £546, but there had been economies, so that the total expenditure increased by £3,096, or 11 per cent. They hoped that by continued economy it would not be necessary to further increase the charges for supply. The lighting restrictions and the Summer-Time Act had adversely affected the output, but the increase for power was over half a million units. Power consumers took about 75 per cent. of the whole output. Sixty employés had already joined the Forces, and their places had been temporarily filled by women, by invalided men, or by unfit men. The chairman referred to the successful efforts of Mr. Renwick, one of the directors, to get the statutory percentage for Excess Profits Duty increased to 7½ per cent. The connections to the mains were better than in 1915, and the units sold increased by 380,217. The profit earned by the sales department increased from £1,733 to £2,034, the turnover for the year exceeding £10,000, and the central showrooms at Brixton had largely contributed to this record result. So far as the current year was concerned, there was a record increase in output; up to the end of February it was 1,879,000 units, or nearly 20 per cent. above 1916. This augured well, but the prospects for the year were difficult to forecast owing to the abnormal conditions. The growth in demand had engaged their serious attention for some time past. As they must look ahead, and machinery and plant were almost unobtainable, they opened negotiations last summer for a supply of energy in bulk from the County of London Co. They had concluded a seven years' agreement on favourable terms for a bulk supply, which was to be available in the late autumn of 1917. It would be initially for 1,500 kw., capable of extension as and when necessary, and would link up the two large generating stations of the County Co. with the South London power house. This would promote economy, safety against breakdown, and would be an asset when negotiating with important factories, &c., for supply. It would also relieve them of considerable capital expenditure, and their invested funds would still be available for feeder and mains extensions. The requisite works for connecting the two companies' systems would be actively taken in hand as soon as official consents had been obtained.

Chelsea Electricity Supply Co., Ltd.—The profit for 1916 was £31,679, plus £3,293 brought forward and £1,810 for interest. Interest on debenture stock absorbs £6,678, there is put to reserve for renewals, depreciation, and contingencies £15,300, to debenture stock premium redemption fund £816, written off cost of extinction of founders' shares £1,089, 6 per cent. is paid on the preference shares, and 3 per cent. on the ordinary shares, carrying forward £3,684. There were added during the year 7,688 new lamps making the total 327,528; units sold, 4,271,470, an increase of 78,578. During the year £53,212 debenture stock acquired by the company was cancelled, reducing the debenture debt to £121,788. Annual meeting: April 4th.

Direct Spanish Telegraph Co., Ltd.—After payment of income-tax and Excess Profits Duty for 1914 and 1915, the balance for 1916 is £57,708. After paying the 10 per cent. pref. dividend, and 5 per cent. dividend and a bonus of 2 per cent., tax free, on the ordinary shares, £5,000 is put to reserve, £3,134 is put to investment fluctuations, and £42,049 is carried forward, subject to the special taxation of profits at present unascertained. The cables and land lines continued in good working order throughout the year.

Launceston & District Electric Supply Co., Ltd.—During 1916 the revenue receipts amounted to £1,102, against £1,233, and the working expenses to £635, against £516. Lighting restrictions and the Summer-Time Act caused the decrease in sales of current. The increased expenditure was largely due to battery cleaning and renewal, and the purchase of two new motors for blowing the fires. The number of consumers increased from 205 to 227, and the lamps connected from 5,631 to 6,413. Gross profit, £466. After deducting bank charges and preference dividend, the net profit is £340, plus £88 brought forward. A dividend of 2½ per cent. is being paid on the ordinary, and after putting £125 to depreciation and smaller sums to reserve and other matters, £37 is to be carried forward.

Coalite, Ltd.—The report states that during the year under review further patents for improvements in the Coalite process have been taken out in all the principal foreign countries, thus maintaining the strength of the company's position in respect of the patent rights. The company's arrangements with the Barnsley Smokeless Fuel Co., Ltd., and British Coalite Co., Ltd., secure for it the benefit of all new inventions, plans, and drawings for the erection of low-temperature plants. The plant of the Barnsley Smokeless Fuel Co. is now on the eve of completion as to the first series of retorts, serious delays having occurred in the delivery of materials owing to the existing stringent war conditions.—*Financier.*

British L. M. Ericsson Manufacturing Co., Ltd.—Mr. W. M. Crowe, presiding at the annual meeting, said that the work they were engaged upon was important, and satisfactory to the Government. The profit on trading was a record, and a large increase over 1915. The stocks in hand and work in progress was £146,647, and had practically all been put in hand against firm orders. They had paid off the £24,000 bank loan, and had £36,843 cash in hand and at the bank. In addition to £13,963 put to depreciation, they had put to reserve for extra depreciation £5,000 to allow for the extra wear and tear to which the plant and machinery had been subjected through working day and night.

Scarborough Electric Supply Co., Ltd.—At the annual meeting, on March 22nd, Mr. G. Alderson Smith said that they had made £67 more from electrical energy, and £63 from meter rents and lamp sales. Coals cost £375 more, and insurances £104 more, but on rents and taxes they had saved £158, and on the distribution of electricity £116. The net result was an increased cost of £314. Mr. A. A. C. Swinton said they were going through very trying times, but he hoped that after the war they would have a good time again. When he arrived at Scarborough on the previous night he drove through the darkened streets, and it was obvious that no electricity company could be prospering.

Bromley (Kent) Electric Light & Power Co., Ltd.—During 1916 the connections increased from 4,254 to 4,499 kw., but lighting restrictions and the effect of the Daylight Saving Bill caused a large reduction in revenue. The profit was £8,573, against £10,529 in 1915, and after paying debenture interest and trustees' fees, amounting to £2,956, and adding £1,672 brought forward, 5 per cent. for the year is paid on the ordinary shares, £2,000 placed to general reserve account, and £1,538 is carried forward. £5,000 has been invested in the new War Loan.

Browett, Lindley & Co., Ltd.—The directors cannot at present submit the audited accounts for 1916 as many questions remain to be decided with regard to Excess Profits Duty and special allowances. The interim preference dividend to June 30th, 1916, has already been paid, and the results of trading justify the payment of the full dividend on the preference shares for the year, also a further 3 per cent. on preference shares on account of arrears (both less tax), also a dividend of 4 per cent. per annum on the ordinary shares (less tax).

Vickers, Ltd.—The directors announce that, under the existing circumstances, it has not yet been possible to present the accounts for the year ended December 31st, 1915, and that the accounts for the year ended December 31st, 1916, must be necessarily also delayed. In the meantime it has been arranged that the final dividend for the year 1916 of 2½ per cent. on the preferred 5 per cent. stock and on the 5 per cent. preference shares will be paid.—*Financial Times.*

British Electric Transformer Co., Ltd.—After paying all manufacturing costs and expenses of administration, the net profit for 1916 is £21,277, plus £4,604 brought forward. There is put to reserve £7,500, and to depreciation reserve £1,500; 6 per cent. on the preference shares absorbs £3,719; 7½ per cent. on the ordinary shares £6,412; directors' extra remuneration £969; carry forward £5,781.

Salisbury Electric Light & Supply Co., Ltd.—The profit for 1916, including £2,289 brought forward, was £7,174. After paying £868 interest on debentures, writing £87 off investments, and paying 6 per cent. for the year on the ordinary shares, £2,000 is carried to depreciation and reserve, carrying forward £2,118.

Robey & Co., Ltd.—Dividend on preferred and ordinary shares for 1916, 6 per cent., less tax, carrying forward £15,121.

P. R. Jackson & Co., Ltd.—Dividend, 10 per cent. for 1916, against 7½ per cent. for 1915.

American Telephone & Telegraph Co.—The report for 1916 states that the net earnings were $44,743,376, which is $3,625,889 more than for 1915. Interest charges were $6,730,098, and dividends at the regular rate of 8 per cent. per annum absorbed $31,122,187. There was carried to reserve $2,500,000, and to surplus $4,391,090.

Cornwall Electric Power Co.—According to the "Financial Times," the company is paying a dividend of 3 per cent. for 1916, against nothing for 1915. £4,000 is put to reserve for plant renewals, and £913 carried forward.

Huelva Gas & Electricity Co., Ltd.—During the first week in January the Association of Mineral Exporters in Huelva took over the working of the electricity department on terms which are still under negotiation.

O. C. Hawkes, Ltd.—Dividend on ordinary shares for 1916, 2½ per cent., free of tax; £500 written off investments, and £6,366 carried forward.

Shawinigan Water & Power Co., Ltd.—Dividend, 1¾ per cent. for the quarter ending March 31st on the common shares.

STOCKS AND SHARES.

Tuesday Evening.

The opening of the market in the War Loan stock has been the principal financial feature of the week. It was expected to have a depressing effect upon other securities; and prices, as we noted last week, were disposed to give way in advance. The establishment of the market, however, has been accomplished with the minimum of disturbance to other securities; and the tone of the gilt-edged markets is distinctly good. This is apparent more particularly amongst Home Railway prior charge issues. Business generally is on the quiet side; and although there remains noticeable animation amongst rubber shares, in other parts of the House, apart from that which deals with the War Loan, no great activity prevails.

It will be noticed that we have added this week the dividends for 1916 in three of the groups of stocks and shares given in our price lists. The tale of 1916 has been practically completed by the issue of the report of the Brompton and Kensington Co. The dividend, as already recorded, will be 9 per cent., as against the 10 per cent. declared since 1903. The net revenue account, however, is only £2,460 down on the year; and the board could have maintained the 10 per cent. dividend had they not pursued the excellent policy of strengthening the reserve fund. The price of the shares remains at 6⅝.

Westminsters are ¼ lower, following upon their rise of 3/16 last week. Preference shares are wanted. City preference and County preference are both ⅛ up. South Metropolitan second preference have risen to 17s. 6d., which is ex the dividend recently paid. The first preference continue to change hands about 21s. 3d.; and the ordinary shares, also ex dividend, are a trifle under £1.

The Telegraph market is better, outstanding features of strength being Eastern ordinary, with a rise of 2, and Great Northern Telegraphs, also £2 to the good. There is little stock to be obtained in this market, and buyers are being continually disappointed in not being able to get what they want. Globe preference continue on offer, and have receded another ⅛. West India and Panama shares gave way to the same extent. Marconis are 1/16 easier, due, as before, to the absence of interest for the time being.

For big figures, the report of the American Telephone and Telegraph Co. is interesting. The total operating revenues of the Bell System were 264½ million dollars, an increase of 30 million dollars. The net non-operating revenues came to a little over seven million dollars; and the total gross income, using the term officially provided by the Inter-State Commerce Commission, was 79 million dollars. The company pays 8 per cent. per annum, and carries forward a surplus of four million dollars.

Home Railway stocks tend to the lower side, but there are no changes worth mentioning in the Underground group, with the exception of falls of 6s. in the "A" shares of the Underground Electric Co., and of a point in the income bonds. Apparently the threatened strike in the North has aroused anew the apprehension of labour troubles elsewhere; and the drastic cutting-down of the omnibus services in London led to a little selling on the part of those who regarded this as a hint that earnings would be further reduced.

In the foreign group, Brazilian Traction common have regained a point at 46¼. There has been further inquiry for the British Columbia Electric Railway stocks, and this week the preferred put on 3 points to 46. Most things connected with Canada continue firm, but the stocks and shares of the various industrial corporations are wavering with New York prices, according to the mood of the moment on the point of the United States' going to war.

Sir Arthur Stanley's suggestion that considerable economies of working could be effected by closer association of electrical supply and power undertakings is likely to receive more consideration now than the same proposals used to do in bygone days, when there was no war to point the advisability of such a course. The idea carries one back to many a period of controversy in the electrical world, and revives

memories of the almost insuperable difficulties that have been found in the past in the way of harmonising different interests. In spite of all obstacles, a good deal has been done in London in the direction of the linking-up of conflicting interests; but far greater economy is possible, and the present offers a fine opportunity on a national scale—an opportunity which it may be hoped will fructify into substantial reform, so far as waste of energy, time, and enterprise is concerned.

Mexican issues are quiet, with scarcely a ripple to disturb the market; and other foreign securities maintain their prices.

British Aluminium ordinary had their rise in advance of the declaration of the dividend of 6 per cent. on the ordinary shares, making 10 per cent. for the year, which goes against 7 per cent. in 1915. The interim dividend had prepared shareholders for a pleasant final distribution, and the company has more than doubled its profits over the period. Industrial shares in this department are decidedly strong. British Insulated ordinary have risen 10s., and so have Henleys; while Callenders are ⅜ up, and several rises have occurred amongst the preference shares. Telegraph Constructions, however, continue dull.

The most active part of the industrial market is that concerned with rubber shares, where the buying went on merrily until the middle of this week, when something of a check took place and prices gave way a little here and there after their rapid advance. Some of the copper shares are better, too, thanks to a favourable dividend announcement by the Rio Tinto Co.; and tin still soaring has quickened the inquiry for shares in companies dealing with the metal.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price Mar. 27, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	9	6⅜	—	£7 11 0
Charing Cross Ordinary	5	—	3⅜	—	7 8 2
do. do. do. 4½ Pref.	4½	—	3 7/16	—	7 1 2
Chelsea	4	3	3	—	6 18 4
City of London	8	—	11½	—	6 19 2
do. do. 6 per cent. Pref.	6	—	10	+ ⅛	6 0 0
County of London	7	—	10½	—	6 16 7
do. 6 per cent. Pref.	6	—	9⅜	+ ⅛	6 8 1
Kensington Ordinary	7	10	5½	—	5 11 7
London Electric	3	—	1	—	Nil
do. do. 6 per cent. Pref.	6	4	3⅜	—	5 6 8
Metropolitan	3	3	2 5/16	—	6 9 9
do. 4½ per cent. Pref.	4½	—	3¼	—	7 4 0
St. James' and Pall Mall	8	—	6¼	—	6 10 8
South London	5	—	3⅜	—	6 19 0
South Metropolitan Pref.	7	—	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅜	— ¼	6 5 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	9¼	—	6 7 8
do. Def.	33 6/-	11½	22	—	6 16 4
Chile Telephone	8	—	6 5/16	—	5 15 3
Cuba Sub. Ord.	5	—	7½	—	6 13 4
Eastern Extension	8	—	13⅜	—	*5 16 4
Eastern Tel. Ord.	8	—	139	+2	*5 15 1
Globe Tel. and T. Ord.	7	—	11½	—	*5 19 2
do. Pref.	6	—	9	— ⅛	6 6 4
Great Northern Tel.	22	—	3 5/16	+2	6 1 0
Indo-European	18	—	46½	—	6 19 9
Marconi	10	—	2 3/16	— 1/16	8 11 0
New York Tel. 4½	4½	—	101	—	4 9 0
Oriental Telephone Ord.	10	—	2½	—	4 14 1
United R. Plate Tel.	8	—	6 9/16	—	*6 2 0
West India and Pan.	6d.	—	7/16	— ⅛	2 12 6
Western Telegraph	8	—	13⅜	—	*5 16 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24	—	4 3 4
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	—	Nil
do. do. "A"	Nil	—	6/-	—6d.	Nil
do. do. Income	6	5	79	—1	*6 6 7
Foreign Trams, &c.					
	Dividend 1914.	Dividend 1915.			
Adelaide Sup. 6 per cent. Pref.	6	6	4 15/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	2⅝	—	9 11 4
do. 2nd Pref.	5½	5½	3⅜	—	—
do. 5 Deb.	5	5	64½	—	7 15 0
Brazil Tractions	4	4	4 ⅛	+1	8 12 0
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	62	—	8 1 4
do. do. Preferred	—	Nil	46	+3	Nil
do. do. Deferred	—	Nil	39½	—	Nil
do. do. Deb.	4½	4½	62¼	—	6 16 0
Mexico Trams 5 per cent. Bonds	—	Nil	27½	—	Nil
do. 6 per cent. Bonds	—	Nil	25	—	Nil
Mexican Light Common	Nil	Nil	7¼	—	Nil
do. Pref.	Nil	Nil	14¼	—	Nil
do. 1st Bonds	Nil	Nil	27½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	27⅝	+ ⅜	5 8 0
British Aluminium Ord.	5	7	28/6	+6d.	7 0 4
British Insulated Ord.	15	17½	13½	+ ½	6 12 1
British Westinghouse Pref.	7½	7½	2½	—	6 0 0
Callenders	15	20	19⅝	+ ⅜	7 18 5
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	34	—	6 13 0
Edison & Swan, £5 paid	Nil	—	7/16	—	Nil
do. do. fully paid	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	66	—	6 1 8
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15⅝	+ ⅜	8 1 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅞	+ ⅛	*8 8 4
Telegraph Con.	20	20	88	—	*6 15 4

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, March 28th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	"	£64	..
a Bisulphide of Carbon	"	£23	..
a Borax	"	£38	..
a Copper Sulphate	"	£63	..
a Potash, Chlorate	per lb.	3/6	..
a " Perchlorate	"	2/-	..
a Shellac	per cwt.	135/-	10/- inc.
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers	"	£32	..
a " Lump	"	£23	..
a Soda, Chlorate	per lb.	1/-	..
a " Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c " Tubes (solid drawn)	"	..	..
c " Wire, basis	"	..	..
c Copper Tubes (solid drawn)	"	1/8½ to 1/9½	..
g " Bars (best selected)	per ton	£174	..
g " Sheet	"	£174	..
g " Rod	"	£174	..
d " (Electrolytic) Bars	"	£161	..
d " " Sheets	"	£176	..
d " " Wire Rods	"	£159	..
d " " H.C. Wire	per lb.	1/7	..
f Ebonite Rod	"	3/-	..
f " Sheet	"	2/6	..
n German Silver Wire	"	2/8	..
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	3/2½	½d. inc.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l " Wire, galv. No. 8, P.O. qual.	"	£88	..
g Lead, English Pig	"	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small	per lb.	6d. to 3/-	..
e " " " medium	"	8/6 to 6/-	..
e " " " large	"	7/3 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/10	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	"	..	..
n " Wire, Nos. 1 to 16	per lb.	3/3	3d. inc.

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Electricity in Dock Construction.—In discussing the recent paper by Mr. P. D. Donald before the Institution of Engineers and Shipbuilders in Scotland, Mr. D. Quinton Bell said with regard to the adoption of steam or electric power in the construction, electricity would have made an undoubted saving in cost and in wear and tear of the plant, but for pile extracting and grab digging, of which a considerable amount was done, electric power was not so suitable as steam, and it was therefore decided to retain steam all through.

Mr. William Burnside, in touching on the same subject, said Mr. Bell started off with a kind of apologia for the use of steam plant, principally cranes, on the work. Steam was preferred to electricity because it was considered more flexible in the operations of grabbing and pile-drawing. He could not commend Mr. Bell's preference. Of course, a steam engine on a crane was a fine buffer, and the control was very sensitive and quick in the hands of a competent crane-driver. Think, on the other hand, of a coal bill reaching to £100 a month on a job of this size, to say nothing of fire hazard. Electric cranes were used every day for grabbing in ore and coal. The use of special gear was probably necessary, such as the Hollick Crypto arrangement and others. As to pile-drawing, he knew of a contract on which over 3,000 piles had been drawn in the last 18 months by means of an extractor used with ordinary electric derrick-cranes. Five-minute rated resistances were used on the steps of the controller, and between these and the brake the piles were drawn without untoward accident, although, perhaps, the practice of using cranes not specially fitted for the purpose was not to be recommended.

Accrington Football.—A football match took place on March 24th, at Moorhead, between the outside staff and the gas plant staff of the Accrington Corporation electricity works. A well-contested game resulted in a win for the outside staff by four goals to one. Following the match, a social evening was spent at the Station Hotel, about 30 attending. Mr. Clegg, the borough electrical engineer, presided.

Electroculture at Minehead.—We understand from Mr. Swarbrick, manager of the Minehead Electric Supply Co., that it is intended to carry out an electrocultural experiment in his district on 1½ acres of potatoes. The company has already made a little progress in power and light supply amongst local farmers.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING FEBRUARY, 1917.

THE February returns of electrical exports and imports show a considerable falling off in values as compared with the previous month, in which, however, business in both sections reached exceptional limits.

The exports of electrical material for the month, valued at £394,062, compared with a total of £556,984 in January, when some £120,000 worth of telegraphic material was included, but not so badly with the December total of £406,000.

The imports reached a total value of £183,192, as compared with £309,381 in January, and with £246,252 in December last, the falling off being, therefore, even more marked in this case.

The re-exports at £31,445 did not fare so badly, the January total being only about £2,000 higher, and both figures being appreciably above the average which obtained during the previous year.

The exports show a general falling off in values, the only exceptions being electric lamp and carbon exports; the value of the telegraphic exports were, however, only fractionally lower than in January. In the case of the imports every section shows a decreased value, and the machinery and lamp imports more particularly so.

One of the most marked features of the war period has been the increasing importance of the European market for our electrical trade. During February, Russia and the Scandinavian countries (principally Norway) formed our best market, while French purchases come next in amount, India being third. American electrical imports into this country were on a greatly reduced scale, as also Dutch and Japanese imports, but French values slightly increased, as compared with the previous month.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	7,290	28,005	659	734	13,062	2,037	22,807	716	247	3,216	12,975	3,975	95,723
Netherlands, Java and Dutch Indies ...	576	3,303	45	45	...	46	186	...	471	...	1,288	742	6,702
Belgian Congo...	...	...	...	...	...	...	...	...	...	...	...	...	...
France	5,472	1,115	1,329	410	1,073	119	14,509	3,225	1,058	37	14,072	211	42,630
Portugal	18	1,067	62	772	...	153	1,008	...	104	2	602	172	3,960
Spain, Canary Isles and Spanish N. Africa...	1,143	662	86	20	...	1,520	2,354	448	...	30	...	46	6,309
Switzerland, Italy and Austria-Hungary ...	644	80	57	52	...	324	8,630	154	578	62	763	1,763	13,107
Greece, Roumania, Turkey and Bulgaria ...	...	...	...	...	...	...	...	...	...	...	...	...	...
Channel Isles, Gibraltar, Malta and Cyprus...	116	79	41	74	...	...	...	...	16	...	101	950	1,377
U.S.A., Philippines and Cuba	1,218	...	133	...	180	20	239	...	...	61	4	12	1,867
Canada and Newfoundland	3	...	52	876	130	124	2,472	25	97	...	...	8,278	12,057
British West Indies and British Guiana ...	7	20	51	40	12	79	66	...	...	60	39	127	501
Mexico and Central America	...	...	28	...	...	...	257	...	...	...	...	...	285
Peru and Uruguay	67	...	4	547	...	...	...	114	11	11	8	9,618	10,380
Chile	138	88	18	176	...	323	180	...	118	3	6	29	1,079
Brazil	77	729	300	391	...	...	645	324	22	...	...	32	2,520
Argentina	1,472	4,507	401	656	...	548	2,179	4,009	2,756	...	1,443	580	18,551
Colombia, Venezuela, Ecuador and Bolivia...	29	125	18	...	...	22	547	29	36	13	38	170	1,027
Egypt, Tunis and Morocco	95	170	167	119	...	64	699	177	...	14	10	...	1,515
British West Africa	69	59	...	95	...	226	140	...	53	8	255	660	1,565
Rhodesia, O.R.C. and Transvaal	682	2,687	1,591	870	...	159	4,774	1,910	1,417	232	185	...	14,507
Cape of Good Hope	714	782	850	733	...	84	6,566	324	213	...	157	266	10,689
Natal	116	1,555	360	285	...	82	1,198	22	703	46	3	65	4,435
Zanzibar, Brit. E. Africa, Mauritius & Aden	66	811	448	372	...	40	55	19	64	...	...	108	1,983
Azores, Madeira and Portuguese Africa ...	...	199	73	23	...	...	1,046	...	...	...	...	77	1,418
French W. Indian Colonies and Madagascar	...	...	...	...	...	...	...	...	...	...	...	12,016	12,016
Persia	35	15	16	...	...	...	...	...	...	...	...	...	66
China and Siam	307	163	750	586	...	2,897	1,808	1,033	135	...	131	972	8,782
Japan and Korea	325	...	9	54	...	569	4,904	...	1,200	1,771	...	...	8,832
India	4,060	10,717	2,624	1,433	42	377	8,177	1,857	3,210	98	844	944	34,383
Ceylon	93	147	180	110	...	79	224	...	80	...	104	154	1,171
Straits Settlements, Fed. Malay States and Sarawak	4	176	597	88	...	51	727	1,427	69	148	114	361	3,762
Hong Kong	91	135	478	...	...	...	378	193	...	...	...	...	1,275
West Australia	330	1,365	1,256	102	...	222	2,920	80	30	...	77	...	6,382
South Australia	174	97	425	43	...	38	1,533	318	1,061	4	78	...	3,771
Victoria	2,364	6,077	71	617	...	441	3,202	...	639	...	1,332	...	14,743
New South Wales	783	5,036	1,789	838	...	1,046	9,854	1,623	679	55	83	23	21,809
Queensland	32	...	25	93	...	15	440	...	...	...	30	5	640
Tasmania	273	...	12	...	...	...	25	...	...	...	...	...	310
New Zealand and Fiji Islands	167	1,308	1,665	1,840	...	700	4,793	1,002	1,548	133	1,003	7,774	21,933
Total, £	29,050	71,279	16,670	13,094	14,499	12,405	109,542	19,029	16,615	6,004	35,745	50,130	394,062

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	...	...	...	49	1,118	...	115	...	...	...	335	1,617
Netherlands	44	...	...	8,499	4,379	...	5	...	2,059	...	5	14,991
France	596	...	...	189	129	590	674	...	7,410	3,639	25	13,252
Switzerland	829	...	...	...	...	165	1,635	6	920	...	53	3,608
Italy	9	3,417	...	...	...	...	...	...	...	...	...	3,426
Japan	204	4,664	4,309	432	...	...	...	...	1,973	...	...	11,582
United States	8,695	1,257	1,302	1,902	303	1,417	7,304	66,062	20,489	7,903	16,586	133,220
Total, £	10,377	9,338	5,611	11,071	5,929	2,172	9,733	66,068	32,851	11,542	17,004	181,696

Additional imports.—Spain, carbons, £1,440; Canada, lamp parts, £43; electrical machinery, £57; batteries, £56.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above ...	4,439	12,138	...	4,870	...	1,852	2,637	...	17	701	3,791	31,445

TOTAL EXPORTS: £394,062 TOTAL RE-EXPORTS: £31,445 TOTAL IMPORTS: £183,192

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned which is not necessarily the country of origin.

THE INTERNATIONAL ALUMINIUM INDUSTRY.

A Prospective Productive Capacity of 150,000 Tons per Annum.

The war has brought to a temporary end, and, in all probability, to a final conclusion for many years, if not for ever, certain international agreements for the regulation of the export trade in different parts of the world. Among these may be mentioned the International Rail Syndicate, the International Dynamite Syndicate, and the International Aluminium Syndicate, whilst the syndicate relations which have existed for years past between certain large groups of electrical manufacturers in the United States and Germany have continued down to the present time.

After the dissolution of the International Aluminium Syndicate in 1908, the sale price of the metal declined from 1s. 7½d. to about 1s. 3½d. per kilogramme, or to a figure which almost represented the cost of production, whilst a further fall took place in the following year. The price, however, was advanced to 1s. 9½d. on the formation of a new syndicate at the beginning of 1913, but no joint sales organisation was associated with the new combination, which naturally expired with the outbreak of hostilities. According to a series of articles published in recent issues of the Paris *Information*, the world's production of aluminium amounted to 46,700 tons in 1911, 50,000 tons in 1912, and 68,200 tons in 1913. The statistics collected by the Chambre Syndicale des Forces Hydrauliques of France show that the United States produced 22,500 tons in 1913, Canada 5,900 tons, Great Britain 7,500 tons, Norway 1,500 tons, Italy 800 tons, France 18,000 tons, and Germany, Austria, and Switzerland 12,000 tons. Before the war the industry was concentrated in comparatively few hands, two groups controlling the production in the United States and Canada, and three in Europe, if the Italian company is left out of consideration for the moment; and as the requirements of the New World absorbed practically the whole of the output there, no interchange of trade took place with Europe. Apart from the imports into British India, the production of the European works was almost entirely consumed in Europe, and, although both France and Great Britain were importing countries to some extent, the Central European countries consumed nearly twice the amount of their own production. In Germany alone the imports of aluminium rose from 8,600 tons in 1909 to 15,500 tons in 1912, of which 6,000 tons were furnished by Switzerland, 4,160 tons by France, and 1,900 tons by Great Britain. At the same time, the German imports of bauxite reached 24,000 tons in 1905, 59,900 tons in 1907, and 38,000 tons in 1913.

The outbreak of war at first produced no effect upon the market for aluminium. On the one hand, the home demand in North America was met by the output there, while, on the other, the Allied countries turned out a quantity in excess of their particular requirements. Gradually, however, the call for the metal became more active for motor cars and for aviation, and since the spring of 1915 prices at New York have rapidly advanced. The consumption in the United States is declared to have increased from 7,000,000 lb. in 1900 to 47,734,000 lb. in 1910, 79,129,000 lb. in 1914, and 99,806,000 lb. in 1915. The price in New York reached as high as 65 cents per lb. in 1916, whilst the price in England, which fell to £60 per ton in the years of depression previously mentioned, has in the past three years varied between £70 and £290.

The augmentation in prices and the development of the consumption have imparted a great stimulus to production. The German group, however, has been much inconvenienced through being deprived of French bauxite. Not only did the group formerly possess various deposits in Provence, but it also owned a works at Saint Louis-les-Aygalades, near Marseilles, for the extraction of alumina from the bauxite, and 126,193 tons of alumina, of the value of £582,000, were sent to Germany in 1913, of which 54,706 tons were re-exported to the United States, Russia, and Great Britain. At present the German and Swiss works have been reduced to the necessity of using the inferior bauxites of Silesia, Hungary, and Dalmatia, and, perhaps, also have to utilise koalin. It is stated in this connection that the Aluminium Industrie A.G., of Neuhausen, exported from 12,000 tons to 14,000 tons of aluminium to Germany in 1915, and of the company's four works, that at Chippis has been specially developed since the outbreak of hostilities. On the other hand, the Swiss-German Giulini company owns alumina works at Ludwigshafen, Germany, and aluminium works at Martigny, Switzerland.

The French newspaper asserts that similarly to the German and Swiss works, the works in France and Great Britain have not been able to be greatly developed under existing circumstances. In contradistinction to this state of affairs, the production in the United States has been considerably increased, and that country now supplies about one half of the world's output. The output of bauxite in the United States is reported to have grown by 35 per cent. in 1915, as compared with the previous year, and to have amounted to 297,000 tons, whilst the production of aluminium advanced from 45,000,000 lb. in 1914 to 80,000,000 lb. in 1915. In this connection, it is mentioned that the Aluminium Co. of America has recently expended £4,000,000 on the development of its plant; a new works of 20,000 H.P. at Maryville, Tennessee, is to begin production this year; the capacity of the Whitney works is being raised to 100,000 H.P. this year; and rolling mills and stamping works at Edgewater, on the river Hudson, were brought into operation in 1916. In addition, the company has acquired certain interests in France, and American groups now own bauxite deposits, it is said, on the river Demerara, in British Guiana, and on the banks of the Surinam, in Dutch Guiana. The Northern Aluminium Co., in Canada, which had a productive capacity of 6,000 tons in 1913, has also extended its works, whilst the Aluminium Corporation, which is the only competitor of the British Aluminium Co., has increased its share capital for the purpose of expanding the Dolgarrog mines. In Norway, five works are either in operation or in course of erection for a combined total output of 16,600 tons; the Bussi works, in Italy, has been greatly enlarged, and a second works is in course of construction in the Aoste Valley for the account of the Società Hydro-Elettrica, of Villeneuve, in which French capital is also interested.

It is estimated that the present capacity of production throughout the world amounts to 100,000 tons per annum, and if the schemes in process of execution are also taken into consideration the capacity will rise to 150,000 tons in the near future. The figures given on this point are as follows:—

	Annual productive capacity in tons.
United States and Canada	75,000
France	20,000
Switzerland and Germany	20,000
Great Britain	12,000
Norway	16,000
Italy	7,000
Total	150,000

The prospects of aluminium becoming dear in price seem rather scanty on the basis of an annual output of 150,000 tons, as it would be necessary for the markets to be greatly developed if over-production were to be avoided. But such a large quantity of metal pre-supposes an output of 300,000 tons of alumina, or 600,000 tons of bauxite, together with a large production of cryolite, fluoride, graphite, &c., for the metallurgical treatment of the metal; and it is considered uncertain whether all these conditions can be fulfilled simultaneously in order to meet the needs of the works.

In conclusion, the newspaper states that the French aluminium industry is protected by the following import duties per cwt. of 50 kilogrammes:—

French Import Duties.

	General tariff.	Minimum tariff.
Ingots and scrap	£3 0 0	£2 0 0
Rolled, wrought or cast	4 9 7	3 0 0
Sheets	12 0 0	8 0 0
Wire	6 0 0	4 0 0
Aluminium powder	8 0 0	6 0 0
Aluminium bronze having a maximum aluminium content not exceeding 20 per cent. ...	10 5	8 0

[The rates in sterling have been converted on the assumption that 25 fcs. are equivalent to £1.]

THE FARADAY SOCIETY.

General Discussion on "Chemical Engineering."

The Faraday Society initiated a discussion on "The Training and Work of the Chemical Engineer" at their last meeting on 6th inst. The meeting, at which there was a very large attendance, was held at the Chemical Society, and was presided over by the President, Sir Robert Hadfield, F.R.S. The opening paper was read by Sir George Beilby, F.R.S., himself not only an eminent chemist and investigator, but withal a successful chemical manufacturer, so that it could not have been in better hands. The academic aspects of the subject were, at the outset, placed in the no less able hands of Prof. F. G. Donnan, F.R.S.

In his introductory remarks the President dwelt on the shortage of the highest class of labour, mental and physical, that will result from the war, and said it therefore behoved us now to set about planning wisely to meet the new conditions. Careful deliberation as a preliminary to action was, however, never more seriously needed, for war conditions were a most fruitful soil for unbalanced proposals, often resulting in panic legislation or action. He fittingly closed his speech on a note that called forth unanimous agreement, namely, an appeal for liberal support of the Ramsay Memorial Fund that was being inaugurated to honour the memory of one of our greatest chemists, and part of which was to be devoted to the establishment of a laboratory for dealing with the very subject under discussion, "Engineering Chemistry."

Sir George Beilby gave the keynote to the discussion in his definition, "*Chemical engineering has for its function the design and construction of apparatus required for the carrying out of chemical processes on a manufacturing scale.*" The discussion practically centred round two standpoints: On the one hand, the view of the great majority that for the construction of chemical plant a man combining within himself the qualities of both chemist and engineer is the type to be aimed at; on the other hand, the view that a man cannot be both chemist and engineer, and that what is needed is closer co-operation between the two. This aspect of the subject was emphasised by Dr. E. F. Armstrong, who, in a very able speech, reminded the meeting that, after all, the chemical industry needed above all *chemists*. Many an existing process might be revolutionised by putting into the works a man closely in touch with modern development in chemistry, say an expert in the phase rule or in colloids. Such men can only be produced by the universities, and if it was true, as the majority maintained, that the university must enter the works, it was no less true that the manufacturer must enter the university, advise it, and support it. The research chemist generally, however, was left somewhat in the background—perhaps too much so—by most of the speakers.

Prof. F. G. Donnan, who spoke on "The Training of the Works Chemist," sub-divided chemists into (1) research chemists, (2) engineer chemists, (3) chemical engineers, and the sub-division was generally adopted as useful. Men of class 1 are the discoverers of new compounds and reactions, and are, of course, absolutely necessary, but to be useful in industry, they should, in Prof. Donnan's opinion, be men of broad outlook whose horizon is not confined to the laboratory. To this end, he advocated teaching them engineering principles and the elements of such practice as may bear on their work, so that they can co-operate intelligently with the other classes. The danger to be borne in mind was stated by Prof. E. G. Coker and others, and was clearly indicated by Sir George Beilby. There is an essential difference between the chemist's and the engineer's type of mind. The former thinks in terms of molecules, the latter in terms of masses. Many a first-rate chemist might be, and is, quite uninterested in engineering, and the training should, therefore, be permissive to some extent, and not obligatory. Dr. W Rosenhain rightly remarked that the proper man, with the right scientific foundation, is bound in the end "to make good."

Men of the second class—engineer chemists—are required in large numbers, and, although essentially chemists, they should received a considerable amount of specialised engineering training, in which stress is laid on thermophysics and thermochemistry, the properties and testing of materials of construction, the principles of design, and the problems of power. The work of these men is really applied physical chemistry. Men of class 3 are thoroughly trained engineers with a chemical sense and some chemical knowledge, the more the better. Prof. Donnan went on to outline the manner in which the work of the three classes of industrial chemists should be co-ordinated for the successful development of a new process after the research chemists have worked it out in the laboratory. Men of classes 2 and 3 should combine to design and test a small trial plant in order to obtain special chemical engineering data, and all three classes should then combine to deal with a technical unit plant fully working, above all quantitatively the thermochemistry and thermodynamics of the process. There can be no doubt that our tendency to keep apart the work of the chemist and the engineer has seriously impaired our industrial efficiency, and Prof. Donnan's suggestions merit the most serious consideration.

Now, as regards the training of our engineer chemists, Sir George Beilby summarised his scheme as follows:—

1. A sound and practical training in chemistry and chemical physics extending over three years. During the third year special subjects to be introduced.
2. At the end of the third year at latest the case of each student to be considered by the heads of the departments, so that he may be advised in what direction he should specialise.
3. Average students with no special bent to complete their course by general advanced studies during the fourth year.
4. No degree or "hall-mark" to be given in chemistry till the complete four years' curriculum has been taken.
5. Chemical engineers, research chemists, and specialists in other branches to devote one or two years to higher post-graduate study.

Mr. W. R. Cooper put in a plea for what he called the forgotten factor in chemical training, namely, the economic factor—will any particular process pay? He considered that even in the educational stage this aspect should not be neglected, and, so far from the commercial consideration placing a problem on a lower plane, it actually introduces an additional factor, and thus renders it more difficult of solution. Perhaps the question of the time at the disposal of the teacher and student is a factor which Mr. Cooper has forgotten! At the Massachusetts Institute of Technology, not only economics and modern languages, but many other branches of knowledge, the utility of which to any citizen nobody can doubt, are included in the curriculum. The meeting was certainly sympathetic to Prof. E. G. Coker, who thought some of the American courses erred on the side of overloading, and who preferred the English method of taking fewer subjects and doing them very thoroughly.

Many other interesting points in schemes of training were emphasised by different speakers. Thus, in talking of the research which should be the culmination of the training of the engineer-chemist, Prof. Donnan suggested that it should take the form of a study of some process promising industrial results, consisting in the investigation of the precise quantitative optimum conditions for the reaction and the actual construction of a small experimental plant for the purpose. To this end, cheap, rough buildings, with the necessary practical equipment and adjuncts, should be attached to our colleges, forming the real "laboratories" of our engineer-chemists.

Mr. Charles R. Darling described the course of physics which chemical students take at the Finsbury Technical College, and Mr. J. W. Hinchley described the teaching of chemical engineering which is being developed as part of a larger scheme of post-graduate study and research in chemical technology at the Imperial College, South Kensington. Many speakers thought the practical training in the laboratory different in kind from that obtained in the works. Mr. A. P. M. Fleming and Mr. W. Gathorne Young therefore advocated the American system of sending students into works during their third or fourth year, and Mr. E. B. R. Prideaux thought the smaller universities should co-operate more closely with the local industries to the same end. Mr. H. L. Heathcote gave voice to the warning that training for the works must be *induced* by the needs of industrial process rather than *forced* by the examination syllabus. Mr. F. H. Carr went so far as to advocate the establishment in colleges of a department which could be conducted something like a factory, carrying on side by side with lectures the production, say, of fine chemicals on the scale of technical experiments. Sir A. McDougall Duckham, on the other hand, thought students should enter works before college. He also advocated teaching chemistry to all engineers, as well as engineering to all chemists. Finally, Prof. A. K. Huntington and Mr. T. G. Elliott referred to a really fundamental difficulty in any scheme of training, and that is the miserable equipment, usually altogether useless, in mathematics and elementary science received at present in the secondary school. In truth, until we reform our schools it is not of very much use to reform our colleges, but that is a subject too wide to consider further at present.

The discussion had the great merit of presenting almost every conceivable point of view of the subject it set out to consider, and it should go far to help crystallise the way of the golden mean, which in practical matters of this kind is the safest way and the best way.

FREQUENCY CHANGERS.

The paper by Mr. R. Townend was read and discussed at a meeting of the Manchester Local Section of the Institution of Electrical Engineers on February 13th.

Prof. Miles Walker said that it was not discreet to connect two large power stations together by means of a synchronous frequency changer unless the motor generator had a fairly large output compared with the output of the power station. In cases of this kind asynchronous sets could be used, and if required to circulate power either way, two sets could be used, one having the synchronous motor connected to the mains of one power supply, and the other having a synchronous motor connected to the other power supply. If it were permissible to introduce a commutating machine into the rotor circuit of the induction motor, as proposed by Leblanc 20 years ago, all sorts of possibilities presented themselves, not only of controlling the power factor of the induction motor and making it take wattless load as an asynchronous generator, but also of circulating power in either direction through the set, independently of the speed of the connected power stations. For example, a frequency changer might consist of a 12-pole, 50-cycle synchronous generator direct connected to a 10-pole induction motor connected to the 40-cycle supply. The set would run at 500 r.p.m., so that the induction motor would be running at 4 per cent. above synchronous speed, and would tend to deliver power to the 40-cycle circuit. If now the rotor circuit of the induction motor were connected to a phase advancer whose excitation was so arranged that it boosted against the e.m.f. generated in the rotor conductors, the asynchronous machine could be made to operate as a motor, notwithstanding the fact that it was running above synchronous speed; and, at the same time, by suitable arrangement of the field coils the power factor could be kept near unity or leading. Moreover, when the asynchronous machine was required to supply a generator load, the phase advancer could be used to supply the wattless component of the load. The type of frequency changer referred to under class 2 in the paper had the advantage that the size of the unit for a given output could sometimes be made considerably smaller than the class 3 type, and when combined with a Leblanc exciter this type of frequency changer seemed very attractive. The phase advancer could be made to operate as successfully as the exciter of a synchronous motor, and the future would show many valuable uses to which it could be put. By the addition of a phase advancer to the induction type of frequency changer all the advantages

possessed by the synchronous type were obtained, and at the same time the great objection to the rigidity of the coupling, incident to the synchronous frequency changer, was entirely removed. In cases where the synchronous frequency changer was employed, if the field magnet of one of the synchronous machines was wound with a polyphase winding, say as a three-phase machine, it was possible to shift the position of the poles of the magnet relatively to the iron, and in this way secure the same effect as by rocking the stator. The diagram (fig. 1) showed how a three-phase generator could be connected to an exciter and two rheostats, so as to obtain a shifting of the pole through an angle of 60 degrees. If all the exciting current was passed through phases A and B, the resultant field would be A B. If the current after passing through A was equally divided between B and C, the line of the poles would be in phase with A. If all the current was passed through phases A and C, the line of the poles would take a position A C. It was also possible to build a special exciter which would give any required phase position of the excitation on the rotor, and in cases where perfectly synchronous running was required, the exciter operated as a continuous-current generator. If it was required slowly to change the pole position on the rotor in order to produce a slip, the exciter could be operated at the frequency required to produce the desired result.

Mr. H. A. Ratcliff raised the question of the efficiency of a synchronous set, as it appeared that such a machine would have to run at loads sufficiently low to avoid the risk of pulling out of step when linking-up two systems. He asked whether the characteristics of the transmission line had any significant bearing on where the frequency changer was placed, *i.e.*, the high- or low-frequency station. Rocking stators seemed quite correct for small machines, but it was questionable if they could be used for large units. It appeared possible to use resistances or reactances between an incoming machine and a machine on load, in order to reduce the shock on paralleling. He asked whether the adjustment of load

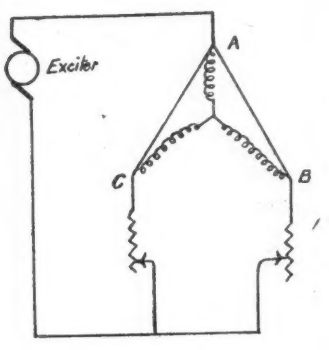


Fig. 1.

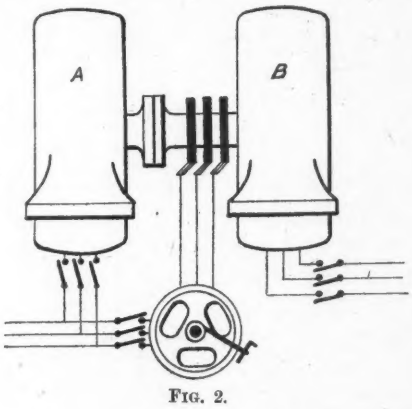


Fig. 2.

between two synchronous frequency changers could not be carried out by varying the excitation of the motors. The operation of reversing the excitation, to "slip a pole," would be rather too severe for the type of field switch generally supplied.

Mr. J. Frith suggested the use of a friction clutch between the two machines of a synchronous frequency changer in order to simplify the operation of paralleling. Each machine would be started up as a motor set, and the two gradually brought together by means of the clutch.

Mr. J. S. Peck described a motor converter with slip rings connected to the connections between the two machines. If the two machines had the same number of poles, the slip-ring frequency would be half the supply frequency, consequently with a 50-cycle supply there was obtainable D.C., 25-cycle A.C., or the two together; or by reverse action D.C., 50-cycle A.C., or both, 25 cycles being supplied to the slip rings.

Prof. A. B. Field said the second class of machine, in which part of the energy was converted mechanically and part electromagnetically, had many points of interest, and its size might be greatly reduced in comparison with the straight synchronous set. Considering the case in which the outfit consisted of two rotating-field machines coupled together, the low-frequency one "A"—assuming this to be the motor—might be an ordinary separately excited synchronous machine, and the generator "B" might comprise a similar stator, and a polyphase-wound rotor fed from the low-frequency side through a potential regulator, as shown diagrammatically in the figure (fig. 2). The maximum mechanical speed of this set consistent with the frequencies was the same as for a straight synchronous set, but the number of poles of the generator corresponded to a higher speed, since the field rotated at a speed greater than that of the shaft. The relative size of the generator stator per kilowatt output depended upon the speed of rotation of its field, not its shaft, and consequently, in comparison with the straight synchronous set, this size was reduced in about the proportion of the shaft speed to the field speed, or in the ratio of the difference of frequencies to the higher one; the same applied, roughly, to the remainder of the set. It would be seen that the advantage in size became greatest when the two frequencies were near together, provided the output was not greater than could be conveniently taken care of with the small number of poles involved for the "B" machine. For example: a linking together of 40 and 50 cycles would allow a maximum speed of 600 R.P.M. with the ordinary synchronous outfit; this corresponded to 8 and 10 poles; 600 R.P.M. would also be the maximum mechanical speed available for the arrangement shown in the figure, but while the "A" machine would retain eight poles, the "B" machine would have two, and would gain the electrical advantages of a speed of 3,000 R.P.M. with only the mechanical difficulties of 600 R.P.M. For a 5,000-KW. transfer, the "A" machine would only be rated at 1,000 KW., plus losses, or less than one-fourth the normal size, while the "B" stator would be that of a 5,000-KW., 3,000-R.P.M. machine instead of a 5,000-KW., 600-R.P.M. It became necessary in order to take care of the variations in voltage on each system to introduce a polyphase induction regulator, and the size of this would depend entirely upon the amount of voltage variation to be provided for, and the reactive drops in the double-wound machine. For example, in a certain 30- to 60-cycle case the possible variations in voltage on both systems under extreme conditions of load and power factor, were estimated to be well taken care of by a ± 15 per cent. voltage regulation. As this regulation needed to be effected in respect of the electrical input to the rotor only, *i.e.*, about half the rating of the set, and as the voltage introduced by the regulator could either assist or oppose the supply, the rating of the potential regulator amounted only to some 8 per cent. of that of the set. However, the use of this subsidiary piece of apparatus, and the necessity of obtaining part of the excitation by alternating current, were distinct drawbacks to this type of frequency changer.

Mr. Swinburne said that since the question of linking-up had become a matter of national interest standardisation of systems, &c., was most desirable. He considered it the duty of the Institution to decide which type of frequency changer should be adopted, and, if necessary, make the adoption compulsory.

Mr. Juhlin referred to the advantages of the synchronous type of machine, also the disadvantage of the induction type when used as a generator owing to the fact that it could not supply any wattless component of the load on the system. He considered the rocking stator to be essential in the case of high-voltage machines of large output in order to avoid shock when paralleling loaded and unloaded machines.

The Author, in reply, said there was no doubt that the use of a phase advancer, in conjunction with an induction frequency changer, would give operating characteristics which were on an equality with, and in some respects better than those of the synchronous set, but in the majority of cases the cost of the former would be higher than that of the latter, also the cost of attendance and maintenance would be slightly greater. The efficiency of synchronous frequency changers would depend upon the rating of the set, but a 1,000-KW. frequency changer having a speed of about 500 R.P.M. would have an overall efficiency of approximately 89 per cent. at full load and 82 per cent. at half load. It was quite correct that the characteristics of the transmission line and the general lay-out of the cable system might in some cases determine whether the frequency changer should be installed at the high- or low-frequency station, but when the line characteristics were of no importance, it was usually immaterial in which station the set was installed. It was not usually practicable to run synchronous and induction frequency changers in parallel, but in some cases it might be done, *e.g.*, 25- and 60-period systems could be linked-up by means of a synchronous set running at 214 R.P.M., and by an induction set operating at 720 R.P.M. When two such sets were running in parallel, the induction set would always carry the load which would give a rotor slip of 4 per cent. There was no great difficulty in building machines with movable stators, and this had been satisfactorily done with machines having a capacity of at least 5,000 K.V.A. With large machines it was advisable to move the stator by means of a motor controlled from the switchboard. The shock caused by paralleling unloaded and loaded synchronous sets could be reduced by inserting resistances or reactances between the loaded and unloaded machines, but this involved additional apparatus and was not so simple as using the movable stator. It was possible to obtain a variation in the load distribution between two synchronous sets running in parallel by varying the motor excitation, but the variation would be small, only about 10 per cent. of full load. There was no difficulty in making a field switch for reversing the field excitation, provided it was mechanically strong, and fitted with an efficient discharge resistance. A friction clutch could be used between the two machines of a synchronous set in

order to simplify the paralleling operation if only one set had to be run, but if a second set had to be paralleled with it, it would be necessary to give the requisite angular displacement between the motor and generator of the incoming set before closing the clutch in order to make the latter set take its share of the load. This, of course, was impracticable. The type of frequency changer described by Prof. Field might be considerably smaller than machines of the third type, but the necessity for an induction regulator and for obtaining part of the excitation by alternating current were distinct disadvantages. It was also necessary to collect the greater portion of the power from slip rings, and in the case of high-voltage machines this was very undesirable. The author did not consider any one type sufficient to meet the requirements of every case, and the only satisfactory method was to adopt the type of machine best suited to the case under consideration. A frequency changer having an A.C. commutator motor instead of an induction or synchronous motor would enable a variable ratio of frequency transformation to be obtained, but the set would not be reversible.

DIESEL ENGINE USERS' ASSOCIATION.

At the January meeting of the Association the President, Mr. Geoffrey Porter, produced an amended and completed table of data concerning lubricating oils, which he asked the Hon. Secretary to circulate among the members and subscribers. A paper on the "Chemistry and Examination of Lubricating Oils" was then read by Mr. Elliott A. Evans, who said that the only oils which could be recommended for lubricating purposes were mineral oils, semi- and non-drying fatty oils, and liquid waxes. Fatty oils alone as lubricants were obsolescent. Mineral oils had won popularity by virtue of their comparative inertia, their cost, and the fact that they could be obtained in almost any degree of viscosity. Texas oils had a specific gravity ranging about 0.950, Californian oils 0.930, and Pennsylvanian oils 0.876/0.910. Mineral oils were mixtures of hydrocarbons belonging to the various homologous series, ranging from the most saturated normal paraffins to the most unsaturated hydrocarbons of the aliphatic series; saturated and unsaturated cyclic hydrocarbons; and aromatic hydrocarbons. In the manufacture of lubricating oils it was the endeavour of the manufacturer to eliminate the unsaturated cyclic hydrocarbons, and all the aromatic hydrocarbons, from the most expensive lubricating oils, because not only were they of very doubtful lubricating value, but their instability might give rise to excessive carbonisation and acidity of the oil. Some Californian oils were on the market, but they could not be recommended universally as lubricants. Texas oils were used to a considerable extent for many purposes, but were very liable to decompose at elevated temperatures, and perhaps at high pressures. It had been found that if a hydrocarbon oil were heated under pressure decomposition took place, and lighter oils resulted. The products of decomposition were generally governed by the temperature and pressure at which the reaction was conducted. When an oil was converted in this manner into lighter oils, the latter were said to be "cracked." During the cracking, carbon was deposited, and some extremely unstable hydrocarbons were formed which decomposed with explosive violence. It was quite conceivable that the explosion in an air compressor at Smithfield occurred through the production of these unstable bodies, and that the vapour of the light oils was exploded by the detonation of these very unstable olefines. That the explosion was caused by the ignition of oil-fog in the compressor might be a very convenient working hypothesis, but it was a little difficult to understand how ignition was effected. The suggestion that a compound oil should be used as a lubricant for air compressors must be condemned. The hypothesis of the oil-fog had created a belief that an oil with a high vaporisation point was essential, but such an oil had a high viscosity, and so unnecessary work was thrust upon the compressor. The vaporisation point as usually determined gave no indication as to the temperature at which vaporisation would take place in the compressor, because the vaporisation point was governed by the pressure of the atmosphere, and the rate of vaporisation was dependent upon the concentration of the vapour in that atmosphere. Mr. Evans expressed the opinion that an oil with a specific viscosity of about 70 (water = 1), or in seconds 2,500, and a closed flash point of about 400 deg. F., could be safely used if the temperature of the compressor was carefully regulated.

At the February meeting of the Association a discussion took place on Mr. E. A. Evans's paper.

In a communication, Mr. T. C. Thomsen said he did not agree that paraffin-base oils changed materially during the process of distillation. He maintained that Pennsylvanian oils were better in quality as lubricants than asphaltic-base oils.

Mr. C. O. Milton referred to the corrosion noted in some air compressors which, he suggested, might possibly be caused by the formation of acids in compressor coils, due to the "cracking" of the lubricating oil used. His own experience had shown that it was possible for the temperatures in an air-compressor to vary over a wide range while the machine, judged by the delivery of air, was working quite well. He thought that possibly the formation of acid might be due to abnormal temperatures in some compressors, the causes of which were now becoming well understood. He had noted a fact in connection with the working of an air compressor at Maidenhead which seemed to confirm this idea. The delivered air was abnormally hot, and there was strong evidence of acid formation in the coils of the higher stages. The engine was overhauled, and the opportunity was taken to fit a non-return valve on the delivery pipe of the compressor. The running of the compressor was then much improved, the delivered air being quite cool, and evidence of acid formation entirely disappeared. The same brand of lubricating oil had been used throughout. He thought it was possible that the former high temperatures were due to lack of tightness of the H.P. valves, and that the added non-return valve had simply improved the efficiency of the delivery valves and prevented pulsating of the air at that point. It was known that leaky valves would cause overheating of the air, and that it was a difficult matter to keep compressor valves continuously tight.

Mr. G. W. F. Horner asked if an air-compressor had ever been designed to work in conjunction with a Diesel engine in which no lubricating oil was used for the compressor cylinders, but in which water was taken in with the air supply to the low-pressure cylinder. Compressors for other purposes were working under such conditions, and he believed that distilled water was the only means of cylinder lubrication for hydrogen compressors. The piston speeds might not be so high, but the pressures were far greater than those required for Diesel engine purposes. He was of the opinion that the most satisfactory lubricating oil for air-compressors was one in which the viscosities had a minimum difference between the temperatures of 60 deg F. and 140 deg. F.

Mr. W. Fennell thought it was quite possible that the fuel oil now being delivered for use in Diesel engines was, owing to war conditions, much richer in sulphur contents than that supplied previously. The sulphur was likely to have a deleterious effect on the lubricating oil in the engine cylinders, especially in the case of a compounded lubricating oil.

Mr. Geoffrey Porter (President) said he would be glad if investigation could be pursued further to ascertain if any particular hydrocarbon base was more liable to favour the formation of unstable hydrocarbons during the decomposition of an oil than was another, and to determine, further, at what critical temperatures these unstable bodies might be formed. One would like to know at what temperature working was safe. If the risk of explosion was more or less in direct proportion to the rise in temperature, one might reasonable conclude that the compression ratios in multi-stage compressors should be arranged at lower values than was generally the case. Generally speaking, all the oils which might be termed "standard" gave satisfactory results under normal conditions; they were chiefly concerned with the endeavour to elucidate the behaviour of oils under abnormal conditions.

Mr. Elliott A. Evans replied at length to the various points raised in the course of the discussion.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

TRANSIT OF GOODS THROUGH FRANCE.—The attention of exporters is drawn to the necessity of obtaining a French import licence for goods which are to pass through France (by parcel post or otherwise) in transit for Switzerland, Spain, or Italy, when such goods are covered by the various prohibitions of importation imposed. Full particulars as to these prohibitions, and as to the procedure to be followed in obtaining French import licences, can be obtained from the Department of Commercial Intelligence, 73, Basinghall Street, E.C.

SOUTH AFRICA.—The following are among recent decisions by the Commissioner of Customs as to the rates of import duty leviable on the articles named :—

	Rate of import duty.	Rebate on goods manufactured in the U.K. and reciprocating British Colonies.
Electrically-heated photographic mounting machine	20 % ad val.	3 % ad val.
Printometer (an electric meter which records the quantity of current used at stated intervals) ...	3 % ad val.	Whole duty
Telephone twine and rubber bands used respectively to lace up cables and deaden vibration of telephone transmitters... ...	3 % ad val.	,, ,,

RUSSIA.—With reference to the temporary prohibition of importation of all goods on private account *viâ* Vladivostock—see

the ELECTRICAL REVIEW of December 22nd—it has now been definitely announced by the Russian Government that, until further notice, no licences for such importation will be granted.

NORWAY.—The exportation of manganese ore, ferro-manganese, emery, and artificial abrasives has been prohibited.

ITALY.—The Italian Government have denounced the existing Treaties of Commerce with Japan, Roumania, Russia, Serbia, Spain and Switzerland. These Treaties will go out of operation at the end of the current year.

BRITISH INDIA.—A Customs Circular has been issued by the Department of Commerce and Industry fixing, with effect from January 1st, 1917, the tariff valuations on various articles imported. The valuations differ in many instances from those previously in operation. Among items of interest to the electrical industry are the following :—

	Tariff valuation. Rs. a.	Duty.
Telegraphic instruments and apparatus, and parts thereof, imported by a railway company...	ad val.	2½ %
Implements, instruments, apparatus and appliances, & parts thereof, not otherwise specified... ...	,,	7½ %
Electrical machinery, and component parts thereof (including belting of all materials for driving machinery)	,,	2½ %
Brass sheets, flat or in rolls, and sheathing, weighing less than 1 lb. per sq. ft.; brass wire ...	ad val.	7½ %
Copper, bolt and bar, rolled ...	,,	,,
,, braziers, sheets, plates and sheathing	cwt. 84 0	,,
,, nails and composition nails	ad val.	,,
,, old	cwt. 50 0	,,
,, pigs, tiles, ingots, cakes, bricks, and slabs	,, 80 0	,,
,, China, white, copperware ...	lb. 2 4	,,
,, wire, including phosphor-bronze, and all other sorts of copper	ad val.	,,
Lead, all sorts (except sheets for tea chests)	,,	,,
Quicksilver...	lb. 3 4	,,
Tin, block	cwt. 140 0	,,
,, foil and other sorts	ad val.	,,
Zinc or spelter, tiles or slabs, soft ...	cwt. 100 0	,,
,, ,, hard...	,, 75 0	,,
,, all other sorts ...	ad val.	,,
Trade catalogues and advertising circulars imported by packet, book, or parcel post	—	Free

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

3,579. "Arrangement of inspection glasses for magnetic brakes." NAAMLOOZE VENNOOTSCHAP HAARLEMSCHE MACHINENFABRIEK VOORHEEN GEB. FIGEE. March 12th. (Holland, March 14th, 1916.)

3,581 & 3,582. "Diaphragms for galvanic cells, &c." R. SCHUSTER. March 12th.

3,583 & 3,585. "Galvanic cells." R. SCHUSTER. March 12th.

3,584. "Galvanic primary cells." R. SCHUSTER. March 12th.

3,592. "Ignition apparatus of submarine mines, and mechanism for automatically raising same." S. J. WILLIAMS. March 12th.

3,604. "Electric cables." C. J. BEAVER & E. A. CLAREMONT. March 12th.

3,610. "Electric switch-boxes." W. T. HENLEY'S TELEGRAPH WORKS CO. AND E. MOOR. March 12th.

3,615. "Electric couplings." H. DE LA VALETTE. March 12th. (France. March 31st, 1916.)

3,618. "Electromagnetic switches for train lighting, &c., installations." A. H. DARKER AND J. STONE & Co. March 12th.

3,652. "Electric circuits linked by relay or repeater." W. H. GRINSTEAD. March 13th.

3,657. "Systems of control." BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO. March 13th. (U.S.A., March 13th, 1916.)

3,658. "Transformation of single-phase alternating electric currents into polyphase currents." BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO. March 13th. (U.S.A., March 13th, 1916.)

3,664. "Electric switches." A. H. DARKER AND J. STONE & Co. March 13th.

3,665. "Brush and terminal contact mechanism of dynamo-electric machines." A. H. DARKER AND J. STONE & Co. March 13th.

3,686. "Insulated brush-holders and terminals for magnetos." P. GREEN. March 14th.

3,687. "Electric heaters." G. S. BENT. March 14th.

3,717. "Electric couplings or connections." G. GREEN & F. MAY. March 14th.

3,719. "Electromagnetic clutch." VULKAN MASCHINENFABRIKS AKT. GES. March 14th. (Austria, October 22nd, 1913.)

3,720. "Electromagnetic friction clutch." VULKAN MASCHINENFABRIKS AKT. GES. March 14th. (Austria, October 22nd, 1913.)

3,727. "Electric control apparatus." BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO. (Westinghouse Electric & Manufacturing Co., U.S.A.). March 14th.

3,748. "Rollers for tramway overhead equipment." J. DUGGAN. March 15th.

3,765. "Sparking plugs for internal-combustion engines." A. G. FRANCE. March 15th.

3,767. "Brushes for dynamo-electric machinery." TROUP, CURTIS & Co. AND J. H. WICKETT. March 15th.

3,768. "Brush gear for dynamo-electric machinery." TROUP, CURTIS & Co. AND J. H. WICKETT. March 15th.

3,780. "Electromagnetic friction clutches." W. LANGDON-DAVIES & A. SOAMES. March 15th.

3,798. "Driving mechanism for magnetos." SOC. LORRAINE DES ANCIENS ETABLISSEMENTS DE DIETRICH ET CIE DE LUNEVILLE. March 15th. (France, April 3rd, 1916.)

3,802. "General and electric joint-making washer." C. J. BEAVER AND E. A. CLAREMONT. March 15th.

3,807. "Electric batteries." SVENSKA ACKUMULATOR AKTIEBOLAGET JUNGNER. March 15th. (Sweden, August 8th, 1916.)

3,811. "Crystalline, &c., detectors for electric waves." H. HURM. March 15th. (France, March 21st, 1916.)

3,864. "Electrically depositing metals." E. H. JONES. March 16th.

3,865. "Electric selectors." G. A. BETULANDER. March 16th. (Sweden, March 17th, 1916.)

3,874. "Rheostats." CUTLER-HAMMER MANUFACTURING CO. & IGRANIC ELECTRIC CO. March 16th.

3,881. "Appliances for shaping telegraph, &c., insulators." P. COOPER AND TAYLOR, TUNNICLIFFE & Co. March 16th.

3,884. "Commutators or switchboards for field telephone systems." N. V. FEARNEHOUGH. March 17th.

3,914. "Magneto-electric ignition machines." BOSCH MAGNETO CO. & O. IMRAY. March 17th.

3,916. "Electric bells." F. G. BELL, W. C. DAVEY AND STERLING TELEPHONE & ELECTRIC CO. March 17th.

PUBLISHED SPECIFICATIONS.

1915.

17,962. ELECTRIC SWITCHES. H. K. Trechmann & British Thomson-Houston Co. December 23rd.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

731. WIRELESS TELEGRAPH TRANSMITTERS. G. Marconi & C. S. Franklin. January 17th, 1916. (104,188.)

732. WIRELESS TELEGRAPH TRANSMITTERS. G. Marconi & W. S. Entwistle. January 17th, 1916. (104,189.)

2,569. DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. (General Electric Co., U.S.A.). February 21st, 1916. (104,197.)

2,576. REMOTE CONTROL OF PROJECTORS. J. Brockie and Johnson & Phillips. February 21st, 1916. (104,198.)

2,660. SEMI-AUTOMATIC TELEPHONE EXCHANGE SYSTEMS. C. A. W. Hultman. February 23rd, 1915. (100,113.)

2,701. IGNITION DYNAMOS. C. T. Mason. March 15th, 1915. (100,173.)

2,714. ELASTIC FLUID TURBINES. British Thomson-Houston Co. (General Electric Co., U.S.A.). February 23rd, 1916. (104,208.)

2,725. ELECTRICAL IMPULSE RESPONDERS OR SELECTORS. Relay Automatic Telephone Co. & H. J. Herink. February 23rd, 1916. (104,212.)

3,164. MEANS FOR SUSPENDING AND INSULATING ELECTRICAL CONDUCTORS. Marconi's Wireless Telegraph Co. & H. A. Ewen. March 2nd, 1916. (104,226.)

3,390. ALTERNATING-CURRENT ELECTROMAGNETS. Waygood-Otis, Ltd. (Otis Elevator Co., U.S.A.). March 7th, 1916. (104,229.)

3,391. VACUUM APPARATUS. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 7th, 1916. (104,230.)

3,474. OVERLOAD ELECTRIC SWITCHES OR CUT-OUTS. P. G. van Wijk. March 8th, 1916. (104,233.)

3,501. RAILWAY SIGNALLING APPARATUS. T. Blackburn. March 9th, 1916. (104,235.)

3,798. ONE-PIECE FRAMING FOR MAGNETOS. E. J. J. Salmson. March 14th, 1916. (104,239.)

3,871. APPARATUS OR MEANS FOR SIGNALLING IN CONNECTION WITH RAILWAYS AND THE LIKE. J. D. Benson. March 15th, 1916. (Cognate application 13,138/16.) (104,240.)

4,430. TUMBLING MACHINES AND ELECTROPLATING BARRELS. L. Schulte. March 25th, 1916. (104,245.)

5,171. ELBOWS AND LIKE FITTINGS FOR ELECTRIC CONDUITS. J. Gray & J. Wilkie. (October 7th, 1916.) (104,248.)

5,377. DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. (General Electric Co., U.S.A.). April 12th, 1916. (104,250.)

5,874. MAGNETIC BLOW-OUT FUSES. Switchgear & Cowans and G. H. Neep. April 25th, 1916. (104,257.)

6,809. SEALING AND BONDING GLANDS FOR ELECTRICAL JUNCTION BOXES. G. S. Boothroyd and Callender's Cable & Construction Co. May 12th, 1916. (104,269.)

9,105. ELECTRIC SPARK GAPS. F. G. Simpson. June 28th, 1916. (Convention date not granted.) (100,795.)

11,752. ELECTRIC MOTOR GYROSCOPES AND MEANS FOR MAKING ELECTRICAL CONNECTION THEREWITH. Crucible Steel Co. of America. April 3rd, 1915. (Divided application on 17,895/15.) (101,225.)

12,099. ELECTRIC DRY CELLS. G. L. Tarver. August 26th, 1916. (104,298.)

13,888. MAGNETOS AND DYNAMOS. P. C. Rushen (Bosch Magneto Co.). September 29th, 1916. (104,308.)

15,054. CONTROL SWITCHES FOR ELECTRICALLY-CONTROLLED APPARATUS FOR MEASURING LIQUIDS. O. Anderson. November 11th, 1915. (102,143.)

16,065. MEANS FOR SUPPORTING ELECTRIC LAMPS. Benjamin Electric, Ltd., and E. Fowler. November 9th, 1916. (104,142.)

16,202. ELECTRIC CONTACT-BREAKERS OR INTERRUPTORS. G. F. Cooke. November 11th, 1916. (104,144.)

16,861. APPARATUS FOR THE CIRCULAR GRINDING OF THE COMMUTATORS OF ELECTRICAL MACHINES. A. Norrel. November 24th, 1916. (104,148.)

17,273. CELLS FOR SECONDARY BATTERIES. G. Pearson. December 1st, 1916. (104,320.)

18,064. ORNAMENTAL SHADES AND REFLECTORS. F. A. Andrews & T. G. Allen. December 15th, 1916. (Addition to 22,781/14.) (104,149.)

1917.

249. APPARATUS FOR AUTOMATICALLY RETRANSMITTING THROUGH SUCCESSIVE LINES TELEGRAPHIC MESSAGES RECEIVED FROM A DISTANT STATION. Eastern Telegraph Co., A. Fraser & S. E. Appleton. January 5th, 1917. (104,152.)

314. IGNITION DYNAMOS. C. T. Mason. March 15th, 1915. (Divided application on 2,701/16.) (103,300.)

315. IGNITION DYNAMOS. C. T. Mason. March 15th, 1915. (Divided application on 2,701/16.) (103,656.)